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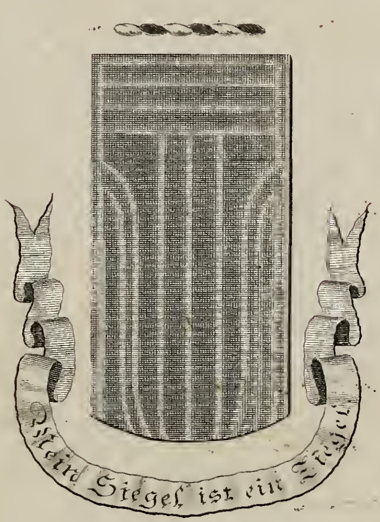
PANNEBAKKER


Des Eid Siegel ist ein Siegel

SAMUEL W. PENNYPACKER.

No K. 22. 47

The Public Library of the City of Boston.

William Duane Jr.

March 28. 1836.

I bought this book at the sale of the library of William Duane Dec. 8. 1882. No better memento of Benjamin Franklin could be desired. It is his own collection of pamphlets relating to electricity and they are filled with references to his discoveries. At least one of them was presented to him by the author, who calls him "Father of electricity" in an autograph note. It contains Franklin's memoranda and it remained in his family until yesterday.

Saml. W. Pennypacker
Dec 9th 1882

March 28. 1836 I bought this Book at the sale of my grandfather's Library. The writing on the next page is Dr. Franklin's to whom this Book formerly belonged.

1 ——

2 - The Philosophy of Earth-quakes

3 Lovet on Electricity.

4 Lettre electrique sur la Mort de M. Richman.

CONJECTURES

ON THE

CAUSE OF THUNDER.

Ut potero explicabo : nec tamen ut Pythius Apollo, certa ut ſint & fixa quæ dixero : ſed ut homunculus, probabilia conjecturâ ſequens. Cic. Tuſc. Quæſt. L. I. C. 9.

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CONJECTURES

ON THE

CAUSE OF THUNDER.

§ 1. THE air is a body originally electric, & while dry is not a conductor of the electrical fire, it does not receive it from other bodies, nor does it communicate it to them; otherwiſe no body ſurrounded by the air, could be electrified poſitively & negatively, for if we should try to electrify it poſitively, the air would immediately carry off the *ſuperplus*, or if it was negatively, the air would ſupply what was wanting (*a*).

2. The electrical fire is equally diffu-

(*a*) Experiments on Electricity. French Tranſlation, *pag.* 92.

ſed through our walls, our apartments; the earth & all the common maſs of matter, thus the glaſs globe turning while it rubs againſt the cusheon, draws the fire from the cusheon, which is ſupplied by the frame of the machine, & the frame by the floor upon which it is placed. *Cut off the communication by means of a thick piece of glaſs, or a cake of roſin placed below the cusheon, no more fire can be produced* (*a*).

3. This experiment proves evidently the above remark, that the air is a body originally electric, that it neither communicates the electrical fire to other bodies, nor receives it from them: and if it ſometimes happens that the air conducts electricity, it is only when it is moiſt or charged with non-electric vapours.

4. We ſuppoſe the conſtituent particles of that element to be ſpherical, and in their interſtices the matter raiſed in ex-

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(*a*) Experiments on Electricity. French Tranſlation, p. 96.

halations to be diſperſed. Theſe exhalations proceed from the mineral, vegetable & animal bodies, which abound over all the ſurface of the earth.

5. But of all the exhalations, that of water is the moſt copious: not to mention the inſenſible perſpiration of organized bodies, in the compoſition of which that element makes a very conſiderable part; the fountains, the rivers, the lakes, &c. with which the whole ſurface of the earth is as it were furrowed, and the ſea (which is indeed the ſource of all) furnish a great quantity of watery vapours. Water is the vehicle of many other exhalations, and one of the beſt conductors of the electrical fluid that we have, in ſo much that a volume of it can be ſubſtituted in place of the metallic conductor, in our common experiments.

6. In the great heats of ſummer, the watery vapours are raiſed in great abundance, as are alſo the other exhalations from mineral, vegetable & animal bo-

dies, and of which a great part is non-electric.

The water thus raiſed is by the influence of the ſun extremely rarified and attenuated, perhaps even nearly reduced to its original elements, as are likewiſe the other exhalations of different kinds.

7. Theſe great heats ſo proper for the raiſing of vapours, ſerve not only to rarify the air, whence neceſſarily proceeds a friction between the conſtituent particles of that element & the matter furniſhed by exhalations, but likewiſe to aſſiſt the inteſtin motion of that matter, which, as it conſiſts of heterogeneous bodies, is ready to undergo a fermentation, and of conſequence, a conſiderable degree of friction amongſt its conſtituent particles.

8. The friction then of the air-globules againſt the non-electric particles raiſed in exhalations, and diſperſed through their interstices, together with the motion, fermentation and friction of the non-electric particles againſt

one another, and of conſequence, againſt the air-globules, is ſufficient for producing a very conſiderable degree of electricity in the atmoſphere, the air-globules being conceived to act as little glaſs-globes, in drawing the electrical fire from the non-electric matter, and communicating it to the particles of water always ready to receive it, while the other non-electric particles do the office of little cusheons.

But it is only in ſuch places of the atmoſphere where there happens to be a proper mixture of the watery particles with the air-globules & the non-electric matter, that ſuch electricity can be excited, or at leaſt it is only from ſuch portions of the atmoſphere, that electrified clouds can be formed.

9. For, in ſuppoſing too great a quantity of the watery particles, the air-globules muſt be ſo drowned, as to render it abſolutely impoſſible for them, to draw the electrical fire from the non-electric matter diſperſed through their in-

terſtices, as in our common experiments, by which we ſee that the glaſs-globe when wet or in contact with water or moiſt vapours in too great a ſurface; is incapable of pumping the electrical fire from the contiguous bodies.

10. In ſuppoſing, on the contrary, too few or none of the watery particles, ſuch portions of the atmoſphere, whatever quantity of electricity may be there excited, muſt be incapable of furnishing thunder-clouds, as it is only the watery particles that are capable of uniting themſelves, & coaleſcing into one denſe body, ſo as to form clouds: thus all the electricity that we can ſuppoſe to be excited in ſuch circumſtances, muſt be diſperſed and diſſipated without producing any conſiderable effects.

11. Beſides, in thoſe places of the atmoſphere, where all or moſt of the exhalations happen to be of the electric kind (which however ſeems rarely to happen) little or no electricity can be excited.

12. In thoſe portions of the atmoſphere, where the water raiſed in vapours, being by the heat of the ſun extremely rarified, ſubtilized and attenuated, does not preſent it's particles to the air-globules, in ſo many or ſo large ſurfaces as to obſtruct or hinder the production of electricity, theſe watery particles, by the cauſes abovementioned, become ſtrongly electrified.

13. The watery particles thus electrified, acquire a repulſive force, recede from one another, are ſtill further rarified and raiſed higher in the atmoſphere; thus their electricity is diſperſed and divided into an innumerable quantity of what we may call atomical points.

The non electric matter from whence theſe watery particles have received their fire, falls inſenſibly to the ground, while they, now ſurrounded by dry air on all ſides, ſtrongly retain their electricity.

14. In this ſtate the watery particles

continue, untill by the winds, cold or other circumſtances, they are condenſed, and form thick clouds.

15. Theſe clouds are ſtrongly electrified, & that fire, which before the condenſation of the ſmall electrified particles which conſtitute them, was diſperſed through ſo great a ſpace of the atmoſphere, as ſcarcely to be ſenſible, & which, in that ſtate, was incapable of producing any remarkable effect, being now united into one body, becomes one of the moſt powerful agents in nature.

16. Clouds electrified in this manner, meeting with others not electrified, tops of mountains, ſteeples, houſes, &c. give a violent shock to theſe bodies, in communicating to them their *ſuperplus* of electrical fire.

In this manner might the electricity of all thunder-clouds be accounted for, were they all poſitively electrified.

17. But the incomparable Mr. FRANKLIN has, by late experiments, diſcovered, that *thunder clouds are for the moſt*

part negatively electrified, that is, *have leſs than their natural quantity of electrical fire*, hence, that moſt frequently, when it thunders, *it is the earth that strikes the clouds, & not the clouds that give a shock to the earth.* This is without doubt one of the moſt beautiful diſcoveries that our age can boaſt of.

18. The ingenious obſerver erected upon the top of his houſe a rod of iron, to receive the electricity from the clouds. Two ſmall bells were placed in ſuch a manner, as to let him know when this rod was electrified (*a*).

Having charged two bottles, the one by the celeſtial fire, the other by the excited glaſs-globe, & ſuſpended between the two by a ſilk thread, a ſmall ball of cork, he found that the ball played with rapidity betwixt the two, & continued ſo to do, untill both the bottles were

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(*a*) Mr. Franklins Letters tranſlated into French by M. Maty. Journal Œconomique pour le mois d'Octobre 1754. p. 153. & Extract of theſe Letters by the ſame, Journal Britannique, p. 239.

equal: this proves that they were differently charged; and as that by the machine was charged poſitively, the other muſt neceſſarily have been charged negatively. This experiment was repeated ſeveral times, with the ſame ſucceſs (*a*).

By preſenting to the rod electrified by lightening, ſeveral bottles electrified in the ordinary way by the hooked wire, he found that the chime ſtopped, becauſe the bottles gave to the rod what the thunder-cloud took from it (*b*).

It remains then that we endeavour to account in a rational manner for the negative electricity of clouds, which, by a little attention to what happens in our atmoſphere, we may, perhaps, attain to.

19. There is without doubt diſperſed through the atmoſphere, at certain

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(*a*) Journal Œconomique, p. 154. Journal Britannique, pag. 240. & 241.

(*b*) Journal Œconomique, pag. 155. & 156. Journal Britannique, p. 241.

times, & eſpecially in the heats of ſummer, a great quantity of ſulphureous vapours, proceeding from the exhalations of mineral ſubſtances, which abound over all the ſurface of the earth.

Though theſe exhalations afford great abundance of ſulphureous matter, yet there ſeems to be another ſource, hitherto unattended to, from whence a very ſubtile, aërial ſulphur may be formed.

20. There appears to be every where diſſeminated through the atmoſphere, a certain quantity of the ſulphureous or vitriolic acid, which is the *acidum vagum* of the great NEWTON, and is probably no more than a certain modification of the ſubſtance of light. Of all the experiments that tend to demonſtrate the exiſtence of this acid in the air, the moſt convincing is that of dipping linnen rags in a ſolution of the pureſt fixt alcaline ſalt, and expoſing them for ſome time to the air, ſo as they may be sheltered from the rain; by which ſimple proceſs,

the alcaline ſalt is changed into vitriolated tartar, which is a neutral ſalt formed by the combination of the ſulphureous acid with the fixt alcali, which could never happen from any other cauſe than the ſulphureous acid contained in the air, and readily attracted by the alcaline ſalt.

21. Other experiments demonſtrate that the ſame acid united with an inflammable matter of any kind, whether of the mineral, vegetable or animal kingdom, forms true ſulphur.

There is without doubt, in the atmoſphere, a great quantity of inflammable matter, proceeding from the exhalations of mineral, vegetable and animal bodies.

I conceive that the ſulphureous acid diſſeminated through the whole atmoſphere, meeting with this inflammable matter, by the aſſiſtance of the heat of the ſun, in the ſummer ſeaſon, and the ſmalneſs of the particles into which itſelf as well as the inflammable matter is reduced, unites itſelf with it, and thus forms extremely ſubtile ſulphureous particles.

22. Mr. FRANKLINS experiments * show, that there is a real difference between reſinous and vitrous electricity, as the late ingenious Mr. DU FAY of the Royal Academy of Sciences had formerly remarked.

Though Mr. FRANKLIN owns that he has not pushed his experiments ſo far as he could have wiſhed, yet it appears pretty evidently from them, that *as the glaſs-globe charges poſitively, ſo the ſulphur one charges negatively*, or in other words, that *the glaſs-globe throws off the electrical fire, & the ſulphur one drinks it in* (*a*).

23. Since then ſulphur electrifies negatively, it follows, that the ſulphureous particles, in ſuch portions of the atmoſphere as contain a great quantity of them, being ſet into motion by whatſoever cauſe it may be, muſt electrify negatively or *minus* the watery particles

(*a*) Letters on Electricity, Part. 2. p. 104.

* This discovery was made by Prof. Kinnersley at Boston & by him communicated to Dr Franklin J.H.G.J.

which may happen to be diſperſed amongſt them.

Several cauſes may concur to ſet the ſulphureous particles in motion. For, I conceive, that in the firſt formation of theſe particles, the ſulphureous acid, in uniting itſelf to the inflammable matter, raiſes a violent motion & effervefcence, that this motion is kept up by the heat of the ſun, a very powerful cauſe, & which might of itſelf be ſufficient to excite a friction amongſt the ſulphureous particles, that this motion, however, is ſtill further increaſed by the fermentation of theſe particles with the heterogeneous matter raiſed in exhalations and diſperſed through the atmoſphere, and by the inteſtin motion which this heterogeneous matter muſt, as we obſerved above, neceſſarily undergo.

Beſides, we learn from an experiment of the ingenious Doctor HALES, that when a pure air & a ſulphureous one meet one another, there ariſes a violent effervefcence between the two, by which a quantity of elaſtic air nearly equal to that of the ſulphureous air, is abſorbed & deſtroyed (*a*). Since the ſame thing muſt happen in the atmoſphere, wherever there is ſulphureous matter, whether it proceed from mineral exhalations, or whether it may have been formed in the atmoſphere by the union of the aërial acid with inflammable matter, in ſuch places of the atmoſphere, the watery particles diſperſed through the interſtices of the ſulphureous ones, muſt be deprived of their natural quantity of electrical fire, not only by the friction excited amongſt the ſulphureous particles by that effervescence, but likewiſe by the deſtruction of the elaſtic air-particles; for, from hence it

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(*a*) Statical Eſſays app. Exp. 3. p. 280. & conſiderations on the cauſes of earthquakes. Phil. Tranſ. N°. 497.

In the ſummer we frequently feel a diſagreable, ſuffocating heat in the air, accompanied with an evidently ſulphureous ſmell, occaſioned, probably, by the effervescence that happens in the formation of the ſulphureous particles, as well as by the abſorption of a certain quantity of elaſtic air.

muſt happen, that the ſulphureous corpuſcles will act at full liberty, in negatively electrifying the watery particles; ſince there are few or no air-particles remaining, which other wiſe might, perhaps, have in ſome meaſure counterbalanced the negative electricity produced by the ſulphureous particles.

Hence, from the violent motion & friction of which theſe laſt mentioned particles are ſuſceptible, we may eaſily conceive, that they muſt act with greater force in electrifying negatively, than the air-globules are capable of in electrifying poſitively, even in thoſe parts of the atmoſphere where they are not mixt with ſulphureous vapours, & may act at full liberty.

24. No ſooner are the watery particles negatively electrified, than they repell & recede from one another, are raiſed higher, & detached from the ſulphureous particles. Theſe (together with ſuch non-electric bodies as may be mixt with them, & which as well as the wa-

tery particles muſt be negatively electrified) are diſperſed by the winds, or fall inſenſibly to the ground, without producing any remarkable effect, as they conſiſt of ſmall diſſeminated corpuſcles, which cannot unite themſelves ſo as to form clouds, as the watery particles do (*a*)

25. Theſe watery particles being con-

(*a*) It is probable, however, that the watery particles carry along with them ſome of the moſt ſubtile of the ſulphureous ones, which may contribute ſomewhat in cauſing that ſtrong ſmell of ſulphur, which ariſes after the clap, in places ſtruck by lightening. From this ſmell, inflamed ſulphureous vapours were imagined to be the immediate cauſe of thunder, thus Lucretius.

Quali naturâ prædita conſtant
Fulmina, declarant ictus, & inuſta vapore
Signa, notæque graves halantes ſulphuris Auras.
L. 6. lin. 218.

But it is certain, that by far the greateſt part of the compoſition of thunder-clouds is nothing but electrified water, & the ſulphureous ſmell ſeems moſtly to proceed from the electrical matter itſelf, for the ſame ſmell diffuſes itſelf very remarkably in apartments where common electrical experiments are performed.

denſed by the cold or other cauſes, form clouds negatively electrified

When a cloud electrified in this manner happens to approach the earth, within the diſtance of the shock, or to meet with others which have their natural quantity of electrical fire, there ruſhes out from the earth, from theſe clouds or from ſuch other bodies as it may meet, a current of electrical fluid in proportion to the extent of the cloud, with a rapidity & violence as great as if it came from the cloud itſelf. It is the shock of this electrical fire ruſhing impetuouſly from the earth, that cauſes moſt of thoſe diſaſters ſo well known even in our northern climates.

A negatively electrified cloud, after it has received from the earth, as much electrical fire as it wants, having ſtruck others which have not been impregnated with their due quantity, receives a ſecond time from the earth, or from other clouds, as much as it has communicated to the others, whilſt theſe ſtrike other clouds, & receive whether from the firſt cloud, or from ſome other, or from the earth, a quantity equal to that which they have parted with; and ſo on, untill all the clouds that are within the reach of the shock, have acquired nearly their natural quantity of electrical matter, or fall to the ground in drops of rain. From hence come thoſe repeated claps, [redacted] & flashes of lightening, which we commonly obſerve when it thunders (*a*).

26. It appears then, that there may be two cauſes productive of thunder-clouds, 1. The particles of water raiſed in exhalations poſitively electrified by the air, 2. Theſe ſame particles negatively electrified by the ſulphureous vapours which abound in many places of the atmoſphere; and by giving a little attention to the forgoing theory, ſeveral queſtions may be ſolved, for example.

(*a*) Mr. Franklins Letters, in the Journal Œconomique above cited, p. 160.

Why a certain degree of electricity is ſo frequently obſerved in the atmoſphere, without either lightening or Thunder (*a*)?

Why thunder is more common in warm climates, and in warm, dry ſeaſons, or after them, than in cold climates, or cold, moiſt ſeaſons?

Why negatively electrified clouds are ſo frequent?

As I have not had leiſure to make ſo many electrical experiments as I could have wiſhed, by which, the above conceptions might, perhaps, be in ſome meaſure verified, and as I am at the ſame time ſenſible how precarious all theories are, which do not eaſily admit of ocular demonſtration, I have not judged proper to give my thoughts under any other title than merely that of Conjectures. It is not my deſign to eſtabliſh a

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(*a*) See Mr. Franklins letters. Journal Œconomique above cited. p. 153, and obſervations on the Electricity of the atmoſphere by the Abbé Mazeas. Phil. Tranſ. for 1753 Vol. XLVIII Part. I. p. 377.

ſyſteme, but to excite others, who have more time and abilities than I, to apply themſelves with diligence to ſuch reſearches.

. . . . Fungar vice cotis acutum
Reddere quæ ferrum valet, exſors ipſa ſecandi.

Ed: Wright M

FINIS.

2.

THE PHILOSOPHY OF EARTHQUAKES, NATURAL and RELIGIOUS.

OR

An Inquiry into their Cauſe, and their Purpoſe.

O Vitæ philoſophia dux, virtutum indagatrix, expultrixque vitii! Cicero.

By *WILLIAM STUKELEY*, M.D.
Rector of St. *George's*, *Queen-Square*; Fellow of the College of Phyſicians, and of the Royal and Antiquarian Societies.

The THIRD EDITION.

To which is added, PART III. on the ſame Subject.

LONDON:
Printed for A. and C. Corbett, at their *Correct State-Lottery-Office* over-againſt St. *Dunſtan's* Church, *Fleetſtreet*.
M.DCC.LVI.

1756.

[Price Two Shillings.]

To the READER.

THE ſubſtance of the philoſophical part of this diſcourſe was delivered at twice to the Royal Society, on March 15, *and* 22: *The theological, in my own church. I could not refuſe the ſolicitation of my friends, hearers in both places, to print it. I wiſh my intention, in the compliance, may any ways prove ſucceſsful; to ſhow, how vain, and unmeaning, are all our philoſophical inquiries, when deſtitute of their true view; to lead us into the more engaging paths of religion. That, from ſpeculation of material Cauſes, we may become adepts in that wiſdom which is from above. Otherwiſe, like* Epicurus, *and the ancient heathen philoſophers, we barter away our immortal part, for a curioſity, that amuſes us to no good purpoſe. Mean are theſe objects of our* *ſenſes to be accounted, in compariſon of our ſpiritual natures, to which our principal regard is due! For we muſt rightly ſay with* Job: Lo, theſe are parts of God's ways, but how little a portion is heard of him? and the thunder of his power, who can underſtand?

To Benjamin Franklyn
Esqr. Father of Electricity
the author.

TO

Martin Folkes, Eſq; L L. D.

Preſident of the Royal Society.

March 26, 1750.

WHEN ſo great and unuſual a *phænomenon*, as an earthquake, and that repeated, happens among us; it will naturally excite a ſerious reflexion in every one that is capable of thinking. And we cannot help conſidering it, both in a philoſophical, and a religious view. Any mind will take the alarm, when we perceive a motion that affects the earth, that bears the whole city of *London*, and ſome miles round it. And at the ſame time while it gives us ſo ſenſible a ſhake, ſo gently ſets us down again; without damage to any buildings, and without a life loſt.

'Tis hard to ſay, which is the greater wonder. But alas! in the works of nature, there are no degrees of great, and little; compariſons are incompatible. We indeed are more affected with what ſeems great in our own apprehenſions:

henſions: I would rather ſay, what is rare and unuſual. An omnipotent power admits of no diſtinctions. And when prodigious effects are produced from cauſes imperceptible, it rightly claims our moſt ſerious attention, as well as wonder. Nor need we loſe ſight of the theological purpoſe of theſe amazing alarms; whilſt we endeavour to find out the philoſophy of them.

Among all the appearances of nature, which are the ſubject of the inquiries of the Royal Society, none more deſerves the regard of a contemplative mind. And among the very numerous accounts received there, from all quarters, being only Obſervations upon the manner of it, and its extent: I judged, it became us to inquire into the *cauſe* of ſo extraordinary a motion: of which we could not form a proper idea; had we not repeatedly ſeen, and felt it.

The moderns have not improved upon the opinions of the ancients, in this matter; any further than by the fancied analogy of ſome chymical experiments. But theſe chymical experiments, and all ſorts of exploſions by gunpowder, and the like, are to me a very unſatisfactory ſolution; they are merely artificial Compoſitions, which can have nothing ſimilar in the bowels of the earth, and they produce their effects by violence, by rending and tearing, by a *ſolutio continui*. This is indeed too often the caſe of earthquakes, but that in a partial degree, not at all equivalent to the compaſs of the ſhock; and is very far from being the conſtant concomitant of an earthquake. Quite the contrary. Innumerable ſuch happen, when there is no breach of the ſurface; and of theſe three or four which we have now felt, nothing of it has appeared. But the immenſity of the vibration of the earth which ſhook every houſe in *London*, with impunity, and for twenty miles round, can never, in my apprehenſion, be owing to ſo unbridled a cauſe, as any ſubterraneous vapours, fermentations, rarefactions, and the like; the vulgar ſolution. Nor does the kind of motion, which I diſcern in an earthquake, in any ſort agree with what we ſhould expect from exploſions.

In order then to proceed with ſome degree of certainty, in our enquiry after the cauſe of earthquakes, it will be uſeful, in the firſt place, to ſet in one view, the general appearances remarkable therein; the moſt uſual concomitants: As we can collect them from our own obſervation, or from the relations and writings of others.

CIRCUMSTANCES.

I. That earthquakes always happen in calm ſeaſons, in warm, dry, ſultry weather; or after a dry, froſty air.

II. That they are felt at ſea, as well as land, even in the main ocean; and at that time, the ſea is calm.

III. That earthquakes differ very much in magnitude. Some ſhake a very large tract of country, at the ſame inſtant of time; nay, ſometime extend to very many countries, ſeparated by mountains, ſeas, lakes, the ocean

IV. That earthquakes differ very much in the quantity, of their vibratory motion: Whence in ſome, tho' largely extended, they are innocuous; in others, both ſmall and great, they lay all in ruin and deſtruction.

V. That a hollow, thundering, unuſual noiſe accompanies them, or rather ſeems to precede the ſhock; which rolls in the air like the noiſe of cannon.

VI. That they are felt more ſenſibly in the upper ſtory of houſes than in the lower.

VII. That the ſhock is more violent upon more ſolid buildings, churches, caſtles, and ſtone-houſes, than upon thoſe of ſlighter materials.

VIII. That many people find themſelves ſick at ſtomach, with headake, and pains in their joints, and the like, which ſometime laſts for the day after, or longer.

IX. That earthquakes generally happen to great towns, and cities, and more particularly to thoſe that are ſituate on the ſea.

X. That earthquakes do not cauſe any damage to ſprings and fountains; but the water in wells becomes foul for a ſhort time.

XI. That they are more frequent in the neighbouring countries of a vulcano.

This laſt circumſtance, in my opinion, has led all inquirers in this queſtion, out of the true path; therefore I propoſe in the enſuing paper,

I. To ſhew what it is not; the inſufficiency of the vulgar opinion, of ſubterraneous fires and vapours.

II. To ſhow what it is in reality, as it appears to me.

III. I ſhall conclude with the moral uſe we ought to make of theſe prodigies of nature.

I. The ſtruggles of ſubterraneous winds and fires, that ſhould heave up the ground like animal convulſions, ſeem to me impoſſible: Their powers, and manner of acting (if ſuch there be) is quite incapable of producing the appearance of an earthquake. That theſe ſhould operate inſtantaneouſly, in one minute, thro' a circle of 30 or 40 miles diameter, or more, I could not conceive. Nor that there ſhould be any poſſible, much leſs ready paſſage thro' the ſolid earth, for ſuch nimble agents, as every one is apt to imagine, that ſpeak of this appearance; without ſufficiently reflecting on the inſuperable difficulties in that *hypotheſis.*

We cannot pretend to deny, that there may be ſuch vapours, and fermentations, inflammable ſubſtances, and actual fires, in the bowels of the earth; and that there may be ſome caverns under ground, as well as we find ſome few above ground: ſuch as *Pool*'s-*Hole*, *The Devil*'s-*Arſe in the Peak* of *Derbyſhire*, and *Okey-Hole* in *Somerſetſhire*. Theſe, I believe, to have been ſo from the creation, never were made by earthquakes. We know, there are hot ſprings running continually: There are ſome vulcano's frequently belching out flames and ſmoke, and to theſe perhaps ſome earthquakes may be owing, tho' not according to the vulgar notion; as we ſhall ſee, by and by.

But theſe matters are very rare, much rarer than earthquakes, both as to time and place. *Veſuvius* in *Italy*, and in that part of it abounding with mines of ſulphur: *Ætna* in *Sicily*, and *Heckla* in *Iceland*; theſe are all we know of, in the old world. In the *Andes* mountains of *America* there are ſome. The ſcarcity of theſe appears to me a ſtrong argument againſt the common deductions made therefrom, as to their being the cauſe of earthquakes.

Nor can I enter into the ſentiments of thoſe that hold the cavernous ſtate of the earth, ſo as to contribute to the forming an earthquake by vapours running from place to place under ground. How many thouſand acres of coal-mines do they daily work in *England*, and have done for ages? I have been myſelf 2 or 300 feet deep in a ſolid rock of native ſalt: I have walked a mile lengthwiſe directly into the earth, and deſcending all the way, in the proportion of one yard in five, 'till we came under the bed of the very ocean, where ſhips were ſailing over our heads. This was at Sir *James Lowther*'s coal-pit, at *Whitehaven*. We were at this time deeper under ground by the perpendicular, than any part of the ocean, between *England* and *Ireland*.

We never hear, from the many hundreds of thouſands of workmen in this kind, at *New-caſtle*, *Nottinghamſhire*, *Yorkſhire*, *Derbyſhire*, *Staffordſhire*, *Somerſetſhire*, and *Wales*: from the infinite nnmbers of workmen in the mines of lead, tin, and the like, of the cavernous ſtate of the earth, ſo as to give any colour for this *hypotheſis* of earthquakes. The earth is generally of ſolid rock; in which there muſt be now, and then, ſome clefts, and vacuities, ſmall in compaſs, as naturally ſo many heterogeneous *ſtrata* of the earth conſolidate together. But there can be no imagination of vapours breaking through, uniting, traverſing ſo ſuddenly, a large ſpace of earth, ſo as to produce thoſe earthquakes, we have ſeen, and felt; much leſs ſuch as we read of. The workmen in all ſorts of mines confeſs by their hard labour, that the earth is not cavernous; nor are there mines of ſulphur, nitre, and the like inflammable materials in *England*. Or if there were, could they burn, and cauſe convulſions of the earth, without proper cavities, pipes, and conveyances of air; as vulcano's, and coal-pits, when ſet on fire. But even from theſe coal-pits, when fired, do we ever find any thing like an earthquake produced. Nor do we find earthquakes frequent in thoſe countries, that abound with coal-mines, as certainly would be the caſe, if that *hypotheſis* was juſt. How eaſy would it be, on the ſlighteſt occaſion for earthquakes to happen in the countries abounding with coal-mines, which are ſo full of artificial cavities communicating with one another, for many miles together: The very thing ſuppoſed, by thoſe who hold the old opinion, of vapours traverſing the earth for that purpoſe.

In the coal-pits, ſome ſmall natural cavities now and then are found; which when opened, ſend forth a peſtiferous vapour, and a fire-damp which runs for a long time together. And tho' there are many ſubſtances that may generate air, within the bowels of the earth; yet theſe matters are infinitely unable to produce an earthquake: Never would have force to open a paſſage for themſelves thro' the ſolid rock, of perhaps many hundred feet in thickneſs. Nor did we obſerve in theſe laſt earthquakes any fire, vapour, ſmoke, or ſmell, any kind of eruption, in the leaſt; as muſt certainly have been, in ſo great a ſtruggle of the ſuperfice, as affected a circle of ſo large a diameter. Were there ſuch, we could ſcarce hope any otherwiſe, than that they would be too ſenſibly felt; to the deſtruction of many thouſands, by their peſtiferous qualities.

Indeed this conſideration alone, of the extent of that ſurface, is ſufficient to overthrow any ſuppoſition, of earthquakes being chiefly owing to ſubterraneous vapours: They cannot momentarily fly under ſo large a tract of ground, if they were near the outward ſhell of the earth. They could not do it without breaking ground, and diſcovering themſelves to the ſight, or ſmell; and that for a long time after. It cannot poſſibly be imagin'd, they ſhould have ſo immenſe a force, as to lift up the city of *London*, and never be perceived by our organs, and outward ſenſes. We have frequent accounts of a little fire-ball burſting in the air, at a diſtance; yet it inſtantly propagates a ſulphureous ſmell around.

If the movement of a ſuperficies of 30 miles diameter was owing to fumes, and vapours; we ought reaſonably to find ſome great diſcharges of them, belching out ſmoke and fire, for a long time after like vulcano's, and coal-pits fired. The operation of the ſhock ought to be of hours continuance, not inſtantaneous; and the evaporation of ſo vaſt a quantity of matter, muſt darken the whole region of the air for a long time after; or require a long time, if gradually it diſcharges itſelf. We ſee how immenſe a volume of ſmoke is produc'd by a very ſmall quantity of gun-powder; and no vapour could be ſo ſubtle, that produc'd ſuch effects, and not be very obvious to our ſenſes.

Even in vulcano's, it is the opinion of the learned *Italian* philoſopher *Borelli*, and of other great naturaliſts, that they are kindled firſt from the ſurface, where there is a poſſibility of ventilation from the air. They imagine, it begins at the top of the mountains; not by any fancied fermentation of the *pyrites* and ſulphureous vapours ariſing from ſubterraneous caverns, in the lower parts of mountains.

There is another conſideration, which utterly overthrows theſe ſuppoſitions, of earthquakes being cauſed by any thing under-ground; and that is a due conſideration of ſprings, and fountains perpetually flowing; and that from the creation of the world to this day. If we would form any tolerable idea of their nature, we muſt needs conceive, that God Almighty has laid their pipes, and canals in the earth, from a great depth, even to the ſurface; like as he has planted the veins, arteries, and glands in an animal body. And likewiſe that they are more and more ramify'd, as they nearer approach the outward ſhell of the earth; juſt ſo our veins, and arteries, as they come nearer the ſkin.

The workmen in coal-mines, and thoſe of metals, minerals, and ſtone-quarries, never fail to meet with ſprings, and currents of water, every where. Often they ruin, and divert ſprings another way, only by digging into the earth for foxes, and the like. Whenever they dig for wells, in any kind of earth, they commonly find ſprings. The colliers, and workers of mines, are oblig'd to drain the waters off with very great Expence.

Theſe are circumſtances not favorable to ſubterraneous fires being in the earth in abundance; much leſs to their being the cauſe of earthquakes. And further, we cannot poſſibly think of earthquakes doing their work that way, without abſolutely ruining the whole ſyſtem of ſprings, and fountains, throughout the whole country, where they paſs. But all this is quite contrary to fact; even where an earthquake has been repeatedly. For an inſtance from home:

On *Wedneſday*, *April* 6, 1580, about ſix in the evening, juſt ſuch another earthquake was felt in *London* and around it, as theſe two we have ſeen. Another exactly ſimilar 1692. In all theſe four, no houſes thrown down, no ſprings diſturb'd thereby, no ſenſible eruptions nor ſmells.

Theſe conſiderations I apply only to this little inconſiderable ſpace, of a circle 30 miles diameter; as with us. But what is that to the earthquakes we read of in hiſtory? In the year of our Lord 17, no leſs than thirteen great and noble cities in *Aſia minor*, were deſtroyed in one night. *Tacitus*, *Pliny*, and many other authors mention it. The fact is ſo notorious, that ſome Perſons here preſent, have ſeen a vaſt block of white marble now ſtanding near *Naples*; being the pedeſtal of a coloſs ſtatue of *Tiberius* the emperor; having carv'd on it the *genius's*, or pictures of all thoſe cities, with their names. The accurate *Bulifon* and others have wrote treatiſes upon it. Theſe cities were rebuilt by that emperor. But without going ſo far, we may ſee another evidence of it, a coin of that emperor ſtruck upon the occaſion, with this inſcription,

CIVITATIBUS ASIAE RESTITUTIS.

I have one of them, in large braſs, which was found at *Colcheſter*.

The compaſs of this earthquake may be reckon'd to take up 300 miles diameter, as a circle. Now, we cannot conceive, how any ſubterraneous vapour can produce ſuch an effect, as inſtantaneouſly to demoliſh all theſe cities; and that ſuch an accident ſhould never happen after. That the whole country of *Aſia minor* ſhould not at the ſame time be deſtroy'd, its mountains be renverſed, its fountains, ſprings, and rivers broken up and ruin'd for ever. Inſtead whereof we find nothing ſuffered, but thoſe cities; no kind of alteration in the ſurface of the country; it remains the ſame as it were in the beginning of time. In 1586 an earthquake in *Peru*, that extended 900 miles.

From theſe conſiderations, I cannot perſuade myſelf, to enter into the opinion of vapours, and eruptions being the cauſe ſought for; and, after we have treated the argument in a ſuperficial view, we muſt go a little deeper.

If we would conſider things like philoſophers, let us propoſe to ourſelves this problem: Where is the power to be plac'd, that is requir'd to move a ſurface of earth 30 miles in diameter?

To anſwer this, conſult the ingineers, and thoſe that make mines in the ſieges of towns; they will acquaint us, that the effect of mines is produced in form of an inverted cone. And that a diameter of 30 miles, in the baſe, will require an *axis* of 15 or 20 miles to operate upon that baſe, ſo as to ſhake it, at leaſt. Now the vapours, or whatever power we propoſe to operate, according to the foregoing requiſite, in order to form the appearance of an earthquake, muſt be 15 or 20 miles deep in the earth. But what mind can conceive, that any natural power is able to move an inverted cone of ſolid earth, whoſe baſe is 30 miles diameter, whoſe axis 20? or was it poſſible; would not the whole texture of that body of earth be quite diſturb'd and ſhatter'd, eſpecially in regard to its ſprings and fountains? but nothing like this is ever found to be the conſequence of an earthquake, though fatal to cities.

Apply this reaſoning to the earthquake of *Aſia minor*, and this vigorous principle at the *apex* of the cone muſt lie, at leaſt, 200 Miles deep in the ground. Enough to ſhow the abſurdity of any moving power placed under the Earth! A cone of 300 miles diameter at baſe, 200 miles *axis:* I dare be bold to ſay, that all the gun-powder made ſince its invention, if put together and fired, would not be able to move it; how much leſs pent up vapours? what muſt we ſay of a circle of 900 miles diameter?

But, could that be admitted as poſſible, would any one be perſuaded, that ſuch a ſubterraneous tumult, of ſo vaſt an extent, will be no ways injurious to the internal ſyſtem of ſprings and fountains, and that this ſhall often be repeated without the leaſt damage? We may as well imagine, that we can ſtab a man 100 times and never touch vein or artery.

Since I gave in my two papers to the Royal Society, a letter of Mr. *Flamſted*'s has been printed, which abundantly confirms my ſentiments. The whole drift of it is, to ſhow how invalid is the vulgar idea conceiv'd, of earthquakes ariſing from ſubterraneous vapours and eruptions: That the earth itſelf is not moved to any depth, and that the ſhock muſt ariſe from the atmoſphere. The circumſtances which he has judiciouſly collected, are extremely agreeable to mine; many of them the very ſame, ſtrongly confirming my *hypotheſis*: And had that great man known the properties of electricity, which we are now maſters of, he would have prevented me in this affair.

" Conſidering (ſays he) what variety of
" ſubſtances, ſand, gravel, ſtones, rock, mi-
" nerals, clay, and mold, our earth is com-
" pounded of, and how little nitre, or ex-
" ploſive matter, a large quantity thereof will
" afford; I cannot think, where we can find
" matter enough to move ſo vaſt a bulk of
" earth, as all the South parts of *England*, all
" the *Netherlands*, with part of *Germany*, all
" *France*, and perhaps *Italy*, (which were
" ſhock'd at once the 8th of *September* laſt
" 1692); or part of *Aſia*, and near all *Europe*,
" which trembled together the ſame day, 91
" years before.

" But, allowing there may have been ſuf-
" ficient matter prepared for theſe purpoſes,
" I can hardly think, there are continued ca-
" vities, at any reaſonable depth, all under
" *Europe*, wherein an exploſion being made,
" might ſhake the whole at once, and yet
" make no clefts, or ſeparations, in thoſe
" parts where the minerals and mountainous
" rocks part from the light mold and clay.

" If an hundred barrels of gun-powder could " be fixed in ſome cave, a thouſand yards under ground; allowing the force of the exploſion ſufficient to raiſe all the weight of " earth incumbent on the cavern; it would " certainly break the looſe mold from any " large ſolid rock we may conceive adjacent, " and leave at leaſt ſome clefts behind it. " But we ſeldom or never hear of ſuch clefts, " made in ſuch places, when earthquakes " happen."

Again, he writes thus: " I cannot apprehend, (if all earthquakes muſt be made by " exploſions in ſubterraneous caverns) why " ſometimes a large country, or whole continent, ſhould be thereby ſhook all at once; " why there ſhould be no eruptions in the " neighbourhood?"

From all circumſtances conſidered, he concludes, that the abſtruſe, effective cauſe of them comes from the air; and that a calm is neceſſary before an earthquake. And theſe two particulars are likewiſe Dr. *Hales*'s poſitions: " The earth-lightning, as he calls it, " is firſt kindled on the ſurface, and not at " great depths, as has been thought; whoſe " exploſion is the immediate cauſe of an earthquake. He ſays, long, dry, hot ſeaſons, " are uſually the preparatory forerunners of

" earthquakes." From all theſe conſiderations I conclude; earthquakes are not caus'd by ſubterraneous vapours.

II. We are to inquire, what is the cauſe of earthquakes.

In an age when electricity has been ſo much our entertainment, and our amazement; when we are become ſo well acquainted with its ſtupendous powers and properties, its velocity, and inſtantaneous operation through any given diſtance; when we ſee, upon a touch, or an approach, between a non-electric and an electrified body, what a wonderful vibration is produc'd! what a ſnap it gives! how an innocuous flame breaks forth! how violent a ſhock! Is it to be wonder'd at, that hither we turn our thoughts, for the ſolution of the prodigious appearance of an earthquake?

Here is at once an aſſemblage of all thoſe properties and circumſtances which we ſo often ſee in courſes of electricity. Electricity may be call'd a ſort of ſoul to matter, thought to be an ethereal fire pervading all things; and acting inſtantaneouſly, where, and as far as it is excited. 'Tis every body's obſervation, that there never was a winter, like the laſt paſt, in any one's memory, ſo extremely remarkable for warmth and dryneſs, abounding with thunder and lightning, very uncommon in winter; coruſcations in the air frequent, juſtly thought electrical by all philoſophers; particularly, twice we had the extraordinary appearance of that called *aurora auſtralis*, with colours altogether unuſual; and this juſt before the firſt earthquake: All the while the wind conſtantly ſouth and ſouth-weſt, and that without rain, which is unuſual with theſe winds.

This ſtate of the atmoſphere had continued five months before the firſt earthquake. Is it not hence reaſonable to conclude, that the earth, eſpecially in our region, muſt be brought into an unuſual ſtate of electricity; into that vibratory condition wherein electricity conſiſts; and, conſequently, nothing was wanting but the approach of a non-electric body, to produce that ſnap, and that ſhock, which we call an earthquake; a vibration of the ſuperficies of the earth.

That the earth was in that vibratory and electric ſtate we have further reaſon to conclude, from the very extraordinary forwardneſs of all the vegetable world with us. Every one knows, that, at the end of *February*, all ſorts of garden-ſtuffs, trees, fruits, and flowers, were as forward as in other years, by the middle of *April*. Conformable to which, experiments abundantly ſhow, that electrifying of plants quickens their growth, equally as in animals it quickens the pulſe. Nor will the unuſual drineſs and warmth of the weather ſolely account for ſuch a precipitate vegetation: becauſe a neceſſary ſupply of rain was wanting, as in the natural ſpring-ſeaſon.

A very long dry froſt will produce the ſame electrical ſtate of the earth, as it equally favours electrical experiments. Thus, *March* 27, 1076, a froſt from the 1ſt of *November* to the middle of *April*, a general earthquake in *England* ſucceeded. *Matt. Paris.* That of *Oxford*, 17th of *September* 1683, was after a froſt. *Jan.* 4, 1680, An earthquake in *Somerſetſhire*: The air was very calm; a froſty night.

Mr. *Flamſted* concurs with us, in our firſt poſition, That earthquakes always happen in *calm* ſeaſons. He adds, "That *Keckerman*, "a learned author, who wrote on the ſubject, "affirms, and backs it from the authority of "*Ariſtotle* and *Pliny*."

The 8th of *September* 1601 was a very calm day but cloudy: And the *Smyrna* merchants obſerve the earthquakes there happen in calm, ſtill weather. The remarkable clearneſs and calmneſs of the morning was obſerved in that of *Oxford* 17th of *September* 1683, and the air continued ſo for five or ſix days after: Therefore we may infer, that it is not impoſſible, what has been abundantly related, that ſome foreigners from *Italy* here in *England*, ſome from the *Weſt-Indies* (in both which countries earthquakes are more frequent than with us) did ſeem to apprehend our firſt earthquake, from the apparent temper of the weather; and obſervations of this kind are as old as *Ariſtotle*. It is obſerved in *Jamaica*, when the air is extraordinary calm, an earthquake is always apprehended.

We had lately read at the Royal Society, a very curious diſcourſe, from Mr. *Franklin* of *Philadelphia*, concerning thunderguſts, lightning, the northern lights, and like meteors. All which he rightly ſolves from the doctrine of electricity. For, if a cloud raiſed from the ſea, which is a non-electric, happens to touch a cloud raiſed from exhalations of the land, when electrified, it muſt immediately cauſe thunder and lightning. The electrical fire flowing from the touch of perhaps a thouſand miles compaſs of clouds, makes that appearance which we call lightning. The ſnap which we hear in our electrical experiments, when re-echoed from cloud to cloud, the extent of the firmament, makes that affrightning ſound of thunder.

From the ſame principle I infer, that, if a non-electric cloud diſcharges its contents upon any part of the earth, when in a high electrified ſtate, an earthquake muſt neceſſarily enſue. The ſnap made upon the contact of many miles compaſs of ſolid earth, is that horrible uncouth noiſe, which we hear upon an earthquake; and the ſhock is the earthquake itſelf.

In the relation received from *Portſmouth*, and the *Iſle of Wight*, concerning the laſt ſhock there, on the 18th of *March*, the writer obſerves, the Day was warm and ſerene, but, upon a gentle ſhower falling in the evening, the earthquake came. Here we have reaſon to apprehend the electrified ſtate of the earth, and the touch of the non-electric: which cauſed the earthquake.

The learned Dr. *Childrey* obſerves, treating on this ſubject, that earthquakes happen upon rain; a ſudden ſhower of rain in the time of a great drought.

'Tis objected, that, if this was the caſe, nothing would be more frequent than earthquakes; but theſe two circumſtances concurring, a ſhower and dry weather, muſt not neceſſarily cauſe it, any more than touching a tube before it is electrified cauſes a ſnap. The earth muſt be in a proper electrified ſtate to produce it; and electricity has its fits; is remitted, intended, ceaſed and recommenced. It has its bounds. All cauſes muſt concur. And now, with us, all neceſſary cauſes did ſo apparently. Tho' a ſhower of rain falling upon the earth when electrified, may cauſe an earthquake, yet too much rain before, will prevent that ſtate of electricity neceſſary.

The day before the cataſtrophe of *Port-Royal*, the weather was remarkably ſerene and clear. In that moſt dreadful earthquake, 1692, of *Sicily*, where 54 cities and towns, beſide a great number of villages were deſtroy'd; but eſpecially the whole city of *Catania*: It was preceded by a moſt agreeable, ſerene and warm ſeaſon, which was the more obſervable on account of its being unuſual at that time of the year.

I have been inform'd, that in the morning of both earthquakes laſt paſt with us, the air was ſerene and calm; on the morning before that 8th of *February*, the air was obſerv'd to be remarkably calm; and that a little before, a black cloud appear'd over great part of the horizon. Dr. *Hales*, in his relation, ſays, the Centinels in *St. James's Park*, and others who were abroad in the morning of the laſt earthquake, obſerv'd a large black cloud, and ſome coruſcations, juſt before the ſhock, and that it was very calm weather: And that, in the hiſtory of earthquakes, they generally begin in calm weather, with a black cloud.

This obſervation precludes the ſuſpicion of earthquakes ariſing from tumults and commotions in the upper, or under region of the air. The remarkable clearneſs of the air before earthquakes, obſerv'd by all, ſhows evidently how free it is from vapours and the like.

Agreeable to our *fifth* poſition, Mr. *Flamſted* writes, " A hollow noiſe in the air always " precedes an earthquake, ſo near that it " rather ſeems to accompany them. He refers " us to *Philoſophical Tranſactions*, No. 151. " *p.* 311. The noiſe was heard by many " that liv'd in the out-ſtreets, and alleys of " *London*, remote from the noiſe and tumult " of the greater ſtreets."

This he ſpeaks of that felt in *London* 1692; but now the whole city heard the noiſe, on both theſe earthquakes of ours.

The gardener, who gave a relation to the Royal Society of what he obſerved in the *Temple*-garden, took notice, that firſt he heard the moſt dreadful noiſe imaginable, which he thought to be a great diſcharge of ſhip-guns, on the river: and that the noiſe rolled from the water-ſide towards *Temple-bar*, rather before the nodding of the houſes.

The gentleman who obſerved it about *Hartingfordbury*, ſays, the noiſe preceded the ſhock. And this is a common obſervation, which at once both ſtrengthens our opinion of electricity, and confutes that of ſubterraneous vapours; for, in the latter caſe, the concuſſion muſt precede the noiſe.

Agreeable to our *ſecond* poſition, Mr. *Flamſted* writes, " That earthquakes are felt at ſea, " equally as on land. Our merchants ſay, " that, tho' the water in the bay of *Smyrna* " lies level, and ſmooth as a pond ; yet ſhips " riding there feel the ſhocks very ſenſibly, " but in a very different manner from the " houſes at land : For they heave not, but " tremble ; their maſts ſhiver, as if they would " fall to-pieces, and their guns ſtart in their " carriages, tho' the ſurface of the ſea lie all ' the time calm and unmov'd." In Dr. *Hook*'s *Philoſophical Collections*, N° 6. *p.* 185, we are told, " That a ſhip felt a ſhock in the main " ocean ; that the paſſengers, who had been " aſleep in their cabins, came upon deck in a " fright, fearing the ſhip had ſtruck upon " ſome rock ; but, on heaving the lead, found " themſelves out of ſoundings."

All this is extremely agreeable to our aſſumption. The water receives the electrical touch, and vibratory inteſtine motion of its parts, as well as land. And the impreſſion may be made ſolely on the water a non-electric, by the touch of an electric fire-ball, or the like; and that ſeems to have been often the caſe. The proper vibratory motion is impreſs'd on the water without ruffling its ſurface; and ſo communicated to all the parts of the ſhip, gives the ſenſe of a ſhock to the bottom, the ſhivering to the maſt, and the reſt of the ſymptoms: which ſufficiently proclaim the cauſe of it to be an electrical impreſſion upon the water. The preſident mentioned a relation of a waterman, that felt it in his boat upon the river; he thought it like a great thump at the bottom of the boat. And ſo the ſhips at ſea fancy, they ſtrike upon a rock.

This makes us apprehend, the reaſon of the fiſhes leaping up out of the canal in *Southwark*, of which we had an account. So in that of *Oxford*, 1683, one fiſhing in the *Charwell* felt his boat tremble under him, and the leſſer fiſhes ſeem'd affrighted by an unuſual ſkipping. That electricity is the cauſe ſought for, ſeems deducible from this conſideration. Several writers on earthquakes aſſimilate theſe vibrations of the earth to thoſe of a muſical ſtring.

Experiments have ſhown, that fiſhes in water may be killed by the particular tone of a muſical ſtring; and 'tis known, that electricity will kill animals. They aſſuredly felt the vibratory motion in the water, which they were abſolutely ſtrangers to before. No doubt it made them ſick; as thoſe of weak nerves on land. And this circumſtance alone precludes any ſuſpicion of ſubterraneous fires under the ocean. Or, if we were to admit of it, would the boiling of the water exhibit any appearance, like what we are ſpeaking of, either to the water, or to the ſhip?

Mr. *Flamſted* likewiſe concurs in our *eighth* poſition, “That many people found themſelves ſuddenly ſick at ſtomach, and their heads dizzy and light; ſo that thoſe that had formerly fits of apoplexies, dreaded their return; particularly, one gentleman, a ſurgeon, feeling himſelf ſo affected, and fearing a return of his apoplexy, reſolved to be let blood, without ſuſpecting the earthquake.”

After theſe two ſhocks which we felt, many people had pains in their joints and back, as after electrifying; many had ſickneſs, headakes, hyſteric and nervous diſorders, and cholicks, for the whole day after, and ſome much longer, eſpecially people of weak nerves, weak conſtitutions; ſome women miſcarry'd upon it; to ſome it has prov'd fatal.

To this we muſt attribute, that relation we had, of the dog lying aſleep before the fire; but upon the Earthquake, he ſuddenly roſe up, run about the room, whining, and endeavouring to get out.

Any ſolid matter is capable of being pu into a ſtate of electricity, ſuch as iron guns; and the more ſo, by reaſon of their ſolidity. And in proportion to it, is the greatneſs of the ſnap, and of the ſhock; and a kind of lambent flame iſſues from the point of contact; and likewiſe ſomewhat of a ſulphurous ſmell: So that if both flame and ſmell were diſcernable in an earthquake; 'tis to be found, without going to the bowels of the earth.

Dr. *Hales* mentions, that ſolid bodies are the beſt conductors of aereal lightning; whence oaks are rent, and iron melted. And in our earthquakes in *London*, the loudeſt noiſe was heard near ſuch large ſtone buildings, as churches, with lofty ſteeples. From the top of theſe we muſt apprehend, that the electrical exploſion goes off into the open air; as in our experiments, from the point of ſwords, and the like.

The electrical ſhock is proportionate to the ſolid electrified, agreeable to our *ſeventh* poſition. This fully accounts for earthquakes in general, and for many in particular. What can be imagined greater than a ſhock of the body of the earth? 'Tis greater, or leſs in proportion to the ſtate of electrification. And now we can account for ſeveral appearances. In the firſt earthquake, the Lord Chancellor, Maſters in Chancery, and ſeveral Judges, were ſitting in *Weſtminſter-Hall*, with their backs to the wall of the upper-end, which is of a vaſt thickneſs. They all relate the ſeverity of the ſhock, from the wall ſeeming to puſh towards them with great violence.

And thus in the earthquake of 1692, *Deal* caſtle is one of them built by *Henry* VIII. the walls are of immenſe thickneſs, and ſtrength; yet they ſhook ſo ſenſibly, that the people living in it, expected it was falling on their heads. And this is the caſe in all earthquakes: the more ſubſtantial the building, the more violent is the ſhock: exactly the mode of electrical vibration. And this Dr. *Hales* takes notice of and others; that an earthquake ſhatters rocks of marble, more eaſily than the *ſtrata* of ſand, earth, or gravel. In the earthquake here of 1692, a great cliff fell down near *Dover*; and part of *Saltwood*-caſtle wall, 'Tis from hence we account for that obſervation, that when we electrify any perſon; upon a touch, the pain and blow of the ſhock is felt at the joints, the wriſt, elbow, and ſhoulder, for inſtance, more than in the intermediate parts; becauſe *there* is the greateſt quantity of ſolid.

At the ſame time, that the force of electricity in ſolids, is as the quantity of matter: we ſee moſt evidently, by innumerable experiments, that water is equally aſſiſtant in ſtrengthning, and conveying the force of electricity; and *that* in proportion too to its quantity. And hence is to be deduced the reaſon of my obſervation; that the moſt frequent and dreadful earthquakes have fallen upon maritime places. And I find the ſame is taken notice of in ſome degree, by *Acoſta*, by *Dolittle*, who wrote on that in 1692, and others.

In the dreadful cataſtrophe at *Port-Royal* then, 'tis notorious, that its violence was chiefly near the ſea. So *Lima* could not ſuffer without its port of *Callao*. Even in thoſe ſo lately felt by us, they were ſenſibly more violent towards the river, than farther from it.

In that earthquake which was felt in *England*, in the year 1692, (which was very much like theſe with us) there were no houſes thrown down, nor Perſons kill'd: but it reach'd more particularly *Sheerneſs*, *Sandwich*, *Deal*, *Dover*, *Portſmouth*, and the maritime parts of *Holland*, *Flanders*, and *Normandy*.

In this that happen'd on *Sunday* the 18th of *March* laſt, at *Bath*; it was felt particularly and ſtrongly at *Portſmouth*, ſeven miles above and below it on the ſea-ſide; all round the iſle of *Wight*, at *Southampton*, the ſea-coaſt of *Selſey*, ſouth of *Chicheſter*, *Arundel*, and the whole coaſt of *Suſſex*, (without going up the land;) and acroſs the ſea to the iſlands of *Jerſey* and *Guernſey*.

On *Monday* night, the 2d of this inſtant *April*, 1750, at ten o'clock, at *Leverpool*, a ſhock of an earthquake. And felt in ſeveral other places in the neighbourhood; but particularly at *Cheſter*, and *Warrington*.

If we look into ancient hiſtory, we find 197 years before Chriſt, an earthquake ſhook terribly the iſle of *Rhodes*, damag'd many cities: and ſome quite thrown down.

Seventeen years before Chriſt, many cities in the iſle of *Cyprus* deſtroy'd.

Six years before Chriſt, the iſle of *Coos* vehemently afflicted.

During the *Peloponneſian* war among the *Greeks*, the iſle of *Delos* ſhaken, and the moſt beautiful temple of *Apollo* thrown down.

Soon after, the city of *Lacedæmon* totally deſtroy'd.

A. D. 79. Three cities in *Cyprus* overthrown.

A. D. 82. The city of *Smyrna* ruined.

In the time of *Valens* the emperor, a terrible earthquake in *Crete*, whereby 100 cities were deſtroyed.

Feb. 13, 1247, An earthquake, chiefly felt in the *Thames*. *Matt. Paris.*

May, 1382, A general earthquake, which did much miſchief; the *Friday* following one leſs; the *Saturday* following, one felt moſtly by water. *Henry de Knyhton.* *Holinſhed.*

A. D. 1456, In the city of *Naples*, 40,000 people loſt.

Conſtantinople has often ſuffered; particularly in 1509, 13,000 people overwhelm'd.

1531, At *Liſbon*, 1400 houſes thrown down; as many ſhatter'd.

April, 1690, The *Leeward-Iſlands*, *Montſerat*, *Nevis*, and *Antigua*: At *Martinico*, and the *French* iſlands, at St. *Lucia*, &c. a violent earthquake,

Dec. 8, 1703, An earthquake at *Hull*, a perfect calm.

1702, At *Strourion*, in *Argyleſhire*, which extended all along the weſt coaſt of *Great Britain*; but to no breadth on land.

Oct. 25, 1734, At *Havant*, in *Suſſex*, conſiderable, the air perfectly calm.

But inſtances enough to ſhow what I aim'd at, that maritime places are moſt ſubject; which is a ſtrong argument in favour of electricity; when both the ſolid of the earth, and the quantity of the water concur, to make the ſhock; exactly as in electrical experiments; when the bottle of water is held in the hand.

Thus when our mind is diſcharged of the prejudices of former notions, we diſcern, that every appearance favours the principle we go upon. That, agreeable to Mr. *Flamſted*, ſubterraneous exploſions, could they pervade, and traverſe the earth at pleaſure, muſt at laſt burſt, and diſperſe every thing in their way. Yet, 'tis not poſſible for us to imagine, ſuch a kind of vibration ſhould follow, either by ſea or land, as that we are treating of. But electricity compleatly anſwers it. This accounts for that ſuperficial movement of the earth, that univerſal inſtantaneous ſhock, which made every houſe in *London* to tremble, none to fall: That quivering, tremulous, horizontal vibration, highly different from any motion we muſt conceive, to be produc'd from ſubterraneous evaporations. Hence authors tell us, *Dec.* 30, 1739, deſcribing an earthquake in the weſt-Riding of *Yorkſhire*: It ſeem'd as if the earth moved backward and forward horizontally; a quivering, with reciprocal vibrations.

Mr. *Flamſted* rightly accounts the motion of earthquakes to be undulatory; and by being continued, cauſes a like motion to a great diſtance. As when you ſtrike a long ſtretched ſtring of wire at one end, the motion is immediately continued to the other. So far he entered into the nature of electricity.

Tho' he be in the right, thinking the cauſe comes from the air, yet what follows contradicts his own hypotheſis. " For if a calm be " neceſſary before an earthquake; then 'tis not " produced by any turbulence in the air. Nor " can we imagine that any aerial commotion, " tho' it may ſhake windows, chimneys, and " the like, ſhall reach 500 miles diſtance, ſplit " the ſolid earth, deſtroy whole cities, and cauſe " thoſe dire deſolations we hear of.

" Mr. *Flamſted* mentions a circumſtance, that " the earthquake here in 1692, was not felt in " the north of *England*, nor in all *Scotland*: for " rain fell that day in both." We may very readily conceive, the earth there was not in an electrified ſtate; and the rain would ſufficiently prevent it. We hence underſtand, how the ſouthern regions ſhould be more ſubject to them, than our northern; where the warmth, and drineſs of the air, ſo neceſſary to electricity, is more frequent than with us.

From electric vibration only can we account for our *tenth* poſition, of ſprings, and fountains being no ways damag'd by earthquakes: The motion goes no deeper into the earth, than the force and quantity of the ſhock reaches; which generally is not far; yet it proceeds lower down when the ready paſſage of a well offers, and *there* affects the water contained in it; puts it into an inteſtine vibration, as to foul it, and raiſe mud from the bottom.

It may ſeem difficult to conceive, how a large portion of the earth's ſurface ſhould be thus capable of electrification. This difficulty is leſſened by reflecting on the nature of electricity, and of the electrical, ethereal fluid pervading all things: how it is excited by the little motion of a ſmall revolving glaſs globe. By this we electrify the moſt ſolid bodies, to the greateſt diſtance, and with a velocity equal to that of lightning.

Dr. *Hales* obſerves, that the uſual exploſion of the cannon on great days, in St. *James's Park*, is obſerv'd to electrify the glaſs, in the windows of the Treaſury.

We muſt conceive, that when the electric ſhock is communicated to one part of the earth, it extends itſelf proportionably to the force of the ſhock, and to the quantity of electrified ſurface; and to the quality of the matter more or leſs ſuſceptible of it, more or leſs apt to propagate it.

Set 1000 men in a row; let every one communicate with thoſe next him by an iron-wire held in their hands: on an electrical ſhock they all feel it alike, at the ſame inſtant; and this gives us a very good idea of the earthquake.

When the earth is broken up in any large degree, 'tis by the ſea-ſide; where ſometimes on a bold ſhore, whole ſtreets tumble into the ſea, or into the gaping earth, now falling toward the ſea. Sometimes on a flat and ſandy ſhore, whole ſtreets are rolled along the level into the ſea.

I am not ſenſible of any real objection againſt our *hypotheſis*, but this, being the *eleventh* of my poſitions, or circumſtances. It ſeems true, that earthquakes are more frequent in *Italy*, near *Veſuvius*, and by *Ætna*, in *Sicily*. And the cauſe ſeems apparently owing to theſe vulcano's. At firſt ſight, every one would think ſo, but not from the true reaſon. This has given the great prejudice to the judgments of the curious, even at this day. But conſider the matter impartially, and it will appear, ſo far from being a ſtrong argument in favour of ſubterraneous eruptions, that it ought to be eſteem'd a convincing proof to the contrary, and moſt cogent in favour of my principle. In ſtricteſt logic, there is no inference to be made from particulars, to generals. Quite the contrary. We have but theſe two or three vulcano's on one quarter of the globe, and two of them toward the warmer climate of it; whereas earthquakes are innumerable, eſpecially in thoſe of a warmer clime. That there are no vulcano's, no diſcharges of fire and ſmoke for a continuance, and abundance, after earthquakes; no ſuſpicion of it either from ſight or ſmell, as we know by innumerable examples, as well as in our own country, and experience: is demonſtration, that this is not the cauſe. If the vulcano's were the real cauſe of earthquakes, we ought aſſuredly to expect, that in the countries thereabouts, the earthquakes ought to be far more extenſive than thoſe in other countries, where are no vulcano's; but this is altogether contrary to experience. For, as the celebrated naturaliſt *Buffon* obſerves, ſuch are not extenſive, as are near *Ætna* and *Veſuvius*. He further adds: *Hiſtoire naturelle*, tom. 1. p. 508. ſpeaking, among many others, of a *vulcano* in the iſland of *Ternate*, he remarks, "That this burning gulph is leſs agitated when "the air is calm, and the ſeaſon mild, than in

" ſtorms and hurricanes;" and ſays, " This
" confirms what I have ſaid in my foregoing
" diſcourſe, and ſeems evidently to prove,
" that the fire which makes *vulcano*'s comes
" not from the bottom of mountains, but from
" the tops, or at leaſt from a very little depth;
" and that the hearth (or floor) of the fire is
" not far from the ſummit of the *vulcano's*;
" for, if this was not the caſe, great winds
" could not contribute to their conflagration."
And this, in general, is a corroborative proof of my whole hypotheſis. For there can be no great fire in the earth, where there is no great conveyance of air.

We have one vulcano in the cold region of *Iceland*, that there is ſometimes an earthquake there; but, in the countries of that northern latitude, and thoſe of leſſer, 'tis obvious in all hiſtory, that earthquakes are leſs frequent than in the more ſouthern. Therefore 'tis eaſy, and very natural to conclude, from all conſiderations weighed together, that theſe vulcano's help to put the earth about them, into that vibratory ſtate and condition of electricity, which is the requiſite in my *hypotheſis*; and by that means only, promote a frequency of earthquakes there.

I have only one circumſtance to add, which may ſeem not inconſiderable; probably perceived by many, tho' not taken notice of. For a whole week before the firſt earthquake, the partition wainſcot of my houſe (between the forward and backward rooms) made an odd kind of tremulous, crackling noiſe continually, as if the wainſcot would ſplit; or as if ſome damage was apprehended to the houſe. This was obſerv'd by the family, with a good deal of concern. *That* in the chamber crackled more than that below. We never perceiv'd it before or ſince, and apparently, it ſhows the vibratory ſtate of the ſurface of the earth, at that time.

But whether our conjectures upon this important ſubject be well founded or no, it certainly becomes a chriſtian philſopher, whilſt he is inveſtigating material cauſes, to look up, and regard the moral uſe of them. For in reality, every thing, the whole world, was ultimately for that purpoſe made. When we ſee ſuch a kind of ſpirituality impreſs'd on mere matter, as this amazing property of electricity, it ſhould kindle in us a high ambition of aſſerting, and exerting the infinitely ſuperior value, and powers, and excellency of the ſpiritual part of us, deſtin'd to an immortal duration. And of all the great and public calamities, which affect us mortals, earthquakes claim the firſt title to the name of warnings and judgments. None ſo proper to threaten, or to execute vengeance upon a guilty people. Nor has any other, thoſe annexed terrors, ſo much of the unuſual, the unavoidable, the ſudden and the horrible apprehenſion of being cruſh'd to death, or buried alive. And when in our own ſight, theſe rare and extraordinary *phænomena* appear, it cannot but be a leſſon to us, to do our duty toward that great Being, who, by a drop of water, can produce effects ſo prodigious.

That earthquakes proclaim themſelves to mankind in this light, is further deducible from this obſervation, the *ninth* in our recapitulation of circumſtances; that they are peculiarly directed to great cities, and maritime towns, thoſe nurſeries of wealth, luxury, and of all the evils naturally flowing therefrom. It would be childiſh to rehearſe from old hiſtory, or modern, a proof of it. We have no other notices of them. Look upon theſe two ſhocks we have here felt. We own that *Hampſted-heath*, and *Finchley-foreſt*, and *Kennington-common* were affected with it; yet it is notorious, that *London* was the center, the place to which the finger of God was pointed.

And this leads us in the *third* place, to conſider the moral uſe and purpoſe of theſe *magnalia naturæ*, and prodigies of the agency of material cauſes. For nothing ſure, but an electrical ſhock, and that from a divine hand, could have been ſo well adjuſted, as twice, nay four times, ſo ſenſibly to ſhake every houſe in *London*, and not throw one down. This duty we will endeavour to execute, from the words of that great man, king *David*.

PSALM xviii. 7.

Then the earth ſhook, and trembled; the foundations alſo of the hills moved, and were ſhaken; becauſe he was wroth.

THIS Pſalm is a triumphal ſong, which *David* deliver'd publickly before God, in thankful remembrance of the great mercies he had receiv'd; being firmly eſtabliſhed on his throne: and all his enemies, foreign or domeſtic, ſubdued.

He does not attribute this happy ſituation of his affairs to his own prudence and courage; but, like a conſummate politician, abſolutely to the mediation of the divine providence. He draws up a moſt grand and magnificent deſcription of the advent of the deity, ſuch as words never before expreſſed. All the heathen pictures of the appearance of their gods, are cold and lame, compar'd to this; which is deſervedly ſo much admir'd by all critics that have any taſte for religion, as well as language.

This verſe, in our text, is the firſt movement in the ſcene, which was to repreſent the appearance of *Jehovah*, without whoſe interpoſition *David* hoped for nothing fortunate.

After deſcribing all the pomp of light, and darkneſs, celeſtial; hailſtones, thunder, lightning, and the like inſtances of majeſty and terror, in the ſkies; he ſtill keeps his eye on the ground, and concludes with the earthquake, where he began.

Then the channels of waters were ſeen; and the foundations of the earth were diſcovered; at thy rebuke, O Lord; at the blaſt of the breath of thy noſtrils.

Our holy pſalmiſt, at other times, has exhibited the ſame images, in different colouring; as a great maſter varies his works, to ſtrike out all the beauties.

Pſal. lxviii. 7. *O God, when thou wenteſt forth before thy people; when thou didſt march thro' the wilderneſs; the earth ſhook, the heavens alſo dropped, at the preſence of God. Even Sinai itſelf was moved, at the preſence of God; the God of Iſrael.*

By this he means, the giving the law. *Exod.* xix. 8. *And mount Sinai was altogether on a ſmoke; becauſe the Lord deſcended on it in fire: and the ſmoke aſcended as the ſmoke of a furnace, and the whole mount quaked greatly.*

Again, Pſal. cxiv. when he is deſcribing the paſſage over the *Red-ſea*, and that over *Jordan*; he brings in the machinery of earthquakes, to teſtify the divine preſence.

When Iſrael went out of Egypt, and the houſe of Jacob from among a ſtrange people; the ſea ſaw it and fled. Jordan was driven back.

The mountains ſkipped like rams: and the little hills like young ſheep.

Then he aſks the queſtion, *What ailed thee, O thou ſea, that thou fleddeſt? and thou Jordan, that thou waſt driven back?*

Ye mountains that ye ſkipped like rams, and ye little hills like young ſheep?

He anſwers: *Tremble thou earth at the preſence of the Lord: at the preſence of the God of Jacob.*

He fails not to attribute theſe marvellous appearances, to their true cauſe. Tho' he knew full well, that the God of nature adminiſtred the ordinary courſe of the earth by ſecond cauſes; yet he could not be ſo blind but to perceive, when the waves of the ocean retreated; when the waters of *Jordan* divided; when mount *Sinai* was all in fire, ſmoke, lightning and thunder, with the trumpet of God ſounding, and the whole mountain ſhaking: he could not but perceive the preſence of the author of nature, in theſe extraordinary appearances.

But every where in ſacred ſcripture earthquakes are particularly ſingled out, above all other natural *phænomena*, as having more of the majeſty and terrific pomp, to denote an immediate operation of God's hand; to excite our fear, and ſhew his anger, as in our text, *becauſe he was wroth.* In imitation of the ſacred writers, the heathen poets, both *greek* and *latin*, expreſs the anger of their *Jupiter* by an earthquake:

Terrificam capitis concuſſit terque quaterque
Cæſariem; cum qua terram, mare, ſidera,
movit. Ovid.

The moving meteors in the free air, lightning, coruſcations, fire-balls, tempeſts, thunders, or the dreaded comets, tho' frightful enough; yet people that do not think to any purpoſe, hope, as they are at a diſtance, to eſcape their effects. But when the terror comes home to us, to our feet; when the earth moves on which we ſtand, what heart is not moved? When our houſes *ſhake* over our ears, the greateſt courage is *ſhaken.*

It is true, an earthquake cauſes an univerſal dread among all ſorts of people; even the philoſopher immerſed in ſpeculation of ſecond cauſes, quakes; as well as the pious, whoſe fear proceeds from ſolid piety: a due ſenſe of the *anger* of the almighty Being.

We ſaw how the late earthquakes affrighted every one; but, as to the generality, it was but for a moment. When they found themſelves ſafe, and alive; thoughtleſs they ran to their buſineſs, or their diverſion: and this not only the firſt, but the ſecond time. And I am apprehenſive, were another, and another to come, they would only be leſs regarded than the preceding. As the *Iſraelites*, to whom miracles became familiar; as the *Jews*, in our Saviour's time, demanding of him to ſhow them a ſign from heaven, in the midſt of the conſtant ſcene of miracles innumerable.

But 'tis my preſent buſineſs to call you to a due and ſerious reflexion, on theſe extraordinary events; by conſidering,

I. What the written word of God, the holy ſcriptures, informs us, concerning the ultimate purpoſe of earthquakes.

II. What we can learn from profane hiſtory.

III. To conclude with our text, that they are ſtrictly and properly divine judgments; *becauſe he was wroth.*

Ever ſince the earth began, earthquakes have been looked on as extraordinary appearances, among the prodigies of nature, and executioners of divine juſtice. In the caſe of *Korah*, *the earth opened her mouth and ſwallowed them up; and* *their houſes, and all the men that pertained unto them; and all their goods.*

In the miraculous victory obtained by *Jonathan*, and his armor-bearer, over the army of the *Philiſtines*, 1 *Sam.* xiv. There was a panic terror infuſed into the *Philiſtines*, and an *earthquake:* it is called *a very great trembling of God.* What the heathen attributed to *Pan*, an imaginary deity of their own making: the *Hebrews* rightly refer'd to the true cauſe, the firſt, and ſupreme.

In the New Teſtament, at our Saviour's death, there was a great earthquake, which was altogether miraculous; as much as the eclipſe of the ſun then. The elements might well ſympathize with the God of nature. *The ſun was darkned, the vail of the temple was rent in twain; the earth did quake, the rocks rent.*

Again, at his reſurrection, *Matt.* xxviii. 2. *There was a great earthquake. The angel of the Lord deſcended from heaven, and rolled back the ſtone from the door, and ſat upon it.*

And for fear of him the keepers did ſhake, and became as dead men.

Matt. xxvii. 54. *When the centurion, and they that were with him, watching Jeſus, ſaw the earthquake, they feared greatly.* See the conſequence of it in one place; and thus in another;

Acts iv. 31. *The Apoſtles,* in the infant Church, *when praying, the place was ſhaken, where they were aſſembled together: and they were all filled with the Holy Ghoſt.* The heathen centurion *feared* upon the earthquake: The chriſtians praying, were *filled with the Holy Ghoſt.*

Acts xvi. 26. When *Paul* and *Silas* were in priſon. *At midnight when they prayed, and ſang hymns to God, ſuddenly there was a great earthquake; ſo that the foundations of the priſon were ſhaken. And immediately all the doors were opened, and every one's bands were looſed.*

Obſerve the conſequence it had upon the goaler; *He called for a light, and ſprang in, and came trembling, and fell down before Paul and Silas, and ſaid, Sirs, what muſt I do to be ſaved?*

The goal trembled; and the goaler trembled, as is obſerved by a writer on this head, an earthquake could *ſoften* his *hard* heart, and *open* what he had *lock'd.* It awaken'd him out of his ſpiritual ſlumber, as well as his natural ſleep, and made his conſcience, as well as the foundations of the priſon, to quake. A bad conſcience is *as a troubled ſea, that cannot reſt, but caſteth up mire, and clay.* The goaler perceiv'd the celeſtial warning, and made a proper uſe of it.

There are many circumſtances in the nature of earthquakes, which render them peculiarly proper to be the inſtruments in God's hand, to give warning to a people, to amend their ways.

The *ſuddenneſs* is one. We ſaw not long ago, what an effect was produced by a ſolar eclipſe, though it was expected long before. We had the prediction, and calculations about it in all our almanacs; yet there was an univerſal ſeriouſneſs that followed it. All that morning, we could walk the ſtreet, without hearing an oath, and the churches were full, in time of prayer. But the *ſuddenneſs* of an earthquake that comes at an inſtant, unthought of, without warning, that ſeems to bring unavoidable death along with it; is able to touch an adamantin heart. To ſee death ſtalking o'er a great city, ready to ſweep us all away, in an inſtantaneous ruin, without a ſingle moment to recollect our thoughts; this is fear without remedy; this is far beyond battle and peſtilence. The lightning and thunderbolt, *the arrow that flieth by day*, may ſuddenly take off an object or two, and leave no ſpace for repentance: but what horror can equal that, when above a million of people are liable to be buried, in one common grave!

Another conſideration that inhances the dread of earthquakes, is the *unavoidableneſs* of the calamity.

lamity. Famine, and war, and rebellion, and peſtilence we may run from, the diſeaſe among the cattle, and locuſts, and the like ſtripes of angry Heaven, we may have ſome chance to eſcape: but no means, no precaution, no remedy, no prudence can ſcreen us, from ſo univerſal a deſolation as this: 'tis as the preſence of God. Whither then can we go to hide ourſelves? Muſt we call upon the rocks and mountains, to cover and ſhelter us from the divine wrath! *And they ſhall go into the holes of the rocks, and into the caves of the earth, for fear of the* LORD, *and for the glory of his majeſty*; *when he ariſeth to ſhake terribly the earth.* Alas, thoſe are the very inſtruments he employs for our deſtruction; to be our tombſtones!

This *unuſual* kind of death too, ſtrikes us with horror; to be buried alive. The earth, the common mother of us all, and the common grave; to eat up her offspring alive; crouds all the images of amazement together, that can enter into the heart of man.

The greater the terror accompanying earthquakes, the greater a bleſſing is our deliverance from the danger of it! What can equal God's power and judgment but his mercy? Conſider the wonderful conſequence; that the whole city of *London* ſhould ſo ſenſibly be ſhaken, and yet no one inhabited houſe to fall; nor one perſon kill'd. Amazing inſtance of power, and goodneſs, in our preſervation! And this not only once, but the ſecond time alſo; though evidently ſtronger was the concuſſion. So ſtrong that almoſt every perſon was throughly perſuaded, that ſome part, at leaſt, of their houſes, was falling down. Can we help admiring, that judgment ſhould be ſo temper'd with mercy! Do we look only at the ſecond cauſes with our unbelievers; and ſport away the divine preſence, as if it was an ordinary occurrence of every day? They want to ſee a miracle. Nought can effect them, but a direct ſupernatural agency.

I anſwer, behold a viſible, and notorious miracle; plainly obvious, and before all their ſenſes. For can there be a greater miracle, can any thing be more directly the finger of God than this, which we ourſelves ſaw with our eyes; that befel the whole city of *London*.

We know the nature of the building of *London* houſes; which ſometimes fall of themſelves, without ſhaking. Wonderful then is it to be thought, and a miracle indeed, that every houſe in this vaſt city, ſhould twice be agitated, and rocked to and fro; and not one fall, nor one perſon receive any damage.

In vain will the philoſophers ſeek for a ſolution of this problem, in natural cauſes only.

By their chymical experiments, they make ſome little mimic imitations of tremors and fumes, and exploſions. So by gun-powder, we ape the regal voice of thunder. But where is the diſcretionary act of mercy, and benignity, that ſeparates between the vengeful and kind? Theſe ſecond cauſes act according to their material nature, like the roaring waves of the ocean, that flow in, and overwhelm every thing, where a breach is made. They can obſerve no diſtinction between the lands of a righteous man, and of a ſinner: they cannot ſtop at a breach, and gather themſelves on an heap, and not enter in at all, as the waters of *Jordan* did.

But in the caſe before us, the hand of the Lord, that ſtayed the flowing of the waters, that quelled the raging of the ſea, and its proud waves; ſets bounds to the trembling of the earth. Hither ſhall its vibrations go, and no further. When alas, if it went but one inch further (in compariſon) a total ruin muſt unavoidably follow.

Conſider this particular, when applied to all the buildings in this immenſe city: and wonder and adore, that almighty providence, which overlooked us, and preſcribed the limits; ſo narrow, ſo preciſe; which ſaved us from univerſal havoc!

II. Did we eſcape; how much happier are we, than the millions that have periſhed by the like calamity? *Joſephus* the famous *Jewiſh* hiſtorian records, that about 29 years before our Saviour's birth, there happened ſuch an earthquake in the country of *Judea*, that 30,000 men periſhed.

In the fifth year of the reign of *Tiberius*, ſo dreadful an earthquake happened in *Aſia minor*, that no leſs than 13 cities were deſtroyed in one night; many of them great, and Royal: *Sardis* in particular, ſaid to be ſecond to *Babylon*.

In *A. D.* 66. Another earthquake happened there, which deſtroyed *Laodicea*, *Hierapolis*, and *Coloſſus*.

A. D. 79. Three cities in *Cyprus* were overthrown.

A. D. 114. The City of *Antioch* ſuffered extremely; whilſt the emperor *Trajan* was in it. And in the 7th year of that emperor, nine ſeveral cities were deſtroy'd in *Aſia*, *Greece*, and *Calabria*.

To come nearer home, and our own times: In 1169, *Catania* in *Sicily* was deſtroyed, and 15,000 people killed.

1692, The whole city deſtroy'd and 18,000 Inhabitants.

1456, At *Naples* 40,000 periſhed by an earthquake.

1531, In the city of *Liſbon*, 1400 houſes were overthrown there, beſides many damaged.

We know the miſerable and deplorable cataſtrophe of *Port-Royal*, in *Jamaica*; which fell out in our own days. My blood ſhudders at the relation of it. And not many months ago, the populous *Lima* in *America*, was wholly overthrown.

Have we not reaſon then to fear, for ourſelves? 'Tis true, we have hitherto eſcaped. But can we tell how ſoon God ſhall let looſe the avenging power of another; which may come, for ought we know, while we are ſpeaking of it. And if it muſt come, happy may it be for us, that it finds us in this place, and ſo doing.

III. And this brings us to conſider the uſes of theſe admonitions; and to ſhow, that they are the effects of the divine anger. *For the earth ſhook and trembled*, ſays the holy pſalmiſt, *the foundation of the hills moved and were ſhaken; becauſe he was wroth.*

And here we cannot poſſibly have a ſtronger and more convincing evidence, of theſe convulſions of nature, being the immediate finger of God, than this ſingle conſideration. Let us but reflect on what has been ſaid, in ſhort;

that theſe viſitations only happen to great and populous cities, to great and eminent ports, and maritime *emporiums* flouriſhing in trade, riches, and luxury.

We hear not of barren deſarts, uninhabited wilderneſſes, wide heaths, and downs, rocky cliffs, and beaches of the ſea, to be the uſual ſubject of earthquakes; but of towns and cities. Not ſo much of little villages, but of thoſe immenſe collections of people. God does not give his warnings to birds, and beaſts of the foreſt; to flocks of ſheep; that punctually execute the reſpective offices he has enjoined them: but to us, the lords of the creation; to whom he has given reaſon, ſenſe, and faculties, to reflect, and judge of things, of our own actions, as well as his; of *his* doings, toward the children of men.

We obſerved before, a plain and notorious proof of God's hand in theſe judgments; that he could move a whole city without throwing down a houſe. And this is moſt aſſuredly a ſecond proof; that he viſits *only* great cities, with theſe judgments. And we muſt conclude this to be as ſtrong an argument of a divine interpoſition in theſe affairs, as any mathematical demonſtration.

Some free-thinkers, or free-livers, when they find, they cannot ſet aſide this reaſoning, ſhelter themſelves, with the hiſtory of God's converſe with *Abraham*; about the cities of *Sodom* and *Gomorrha*; aſſuring themſelves, there is no danger. For though they cannot pretend to be the meritorious people; yet they think God's mercy will be as ſignal to us, as heretofore: and that we have among us, at leaſt ten righteous perſons, to ſave the reſt.

But vain are ſuch hopes: God will ſay to them, as heretofore to the *Jews*: *If I bring my great judgments upon the earth, as I live ſaith the Lord, though* Noah, Daniel, *and* Job *were there; they ſhould ſave neither ſons, nor daughters, but their own ſouls only.*

God can, if he pleaſes, by very extraordinary means, preſerve ſuch as he thinks fit. But in general judgments, the righteous muſt undergo one common fate, with the wicked. God's mercy will be ſhown to them after this life, to make the ſuperabundant amends.

But this is a ſolid leſſon to us, of the neceſſity of a future life. We may as well baniſh God out of the earth, as to deny his attributes of power, and goodneſs, and juſtice, and the like. And theſe will inſure us of a future ſtate; when an exact return will be made for our behaviour in this; otherwiſe we might juſtly expoſtulate, as *Abraham* did, *Will not the judge of all the earth do right?*

Good men, who have endeavoured to do their duty, may ſay, *God is our refuge and ſtrength, a very preſent help in trouble. Therefore will not we fear, though the earth be removed; though the mountains be carried into the midſt of the ſea; though the waters thereof roar, and be troubled; tho' the mountains ſhake with the ſwelling thereof.*

Come, behold the works of the Lord; what deſolations he hath made on the earth.

In the mean time, let us not think on running *away* from the danger, ſo much as on mending our *ways*; perfecting the chriſtian life; reforming the abominable crimes, ſo juſtly chargeable on great and maritime cities; overflowing with riches, pride, and luxury, with vanity, pleaſure, and profaneneſs; with gaming, immorality, infidelity; and eſpecially with the notorious crime of ſabbath-breaking, which is the foundation of all, and comprehends all others; for it prevents people from amending of any. If they fail of their duty towards God, in making their regular approaches to his temple; no wonder they are guilty of all crimes; regard neither God nor man. If they fail of coming, where they may hope for the kindly influences of God's holy Spirit; we need not wonder at their egregious wickedneſs: they become abſolutely irreclaimable.

But of you my beloved brethren, here aſſembled, I hope better things. You ſhun the degenerate corruptions of this evil age; you are not of the number of thoſe that frequent our public meetings of folly, from the morning rendezvouzes to the midnight aſſemblies; and *that* protracted to the morning light again. As if we ought to baniſh all ſerious thoughts of our immortal intereſts; and that in the ſacred ſeaſon of Lent; deſtined by the church, for this very ſerious purpoſe.

Let us think how this warning happened to us, in the time of Lent; when they were revelling in their places of entertainment, both morning and evening, as if no ſuch thing had been; and this on the very days; as if they confronted, and dar'd almighty vengeance. Much of a parallel caſe with that of the famous city of *Herculaneum*, which is now the entertainment of the curious. Firſt it was miſerably ſhattered by an earthquake; whilſt the people were at their diverſions in the theatre; where all aſſembled periſhed. This was in the firſt year of *Titus* the emperor: but ſuch a partial judgment not mending their manners; nine years after, the whole city was deſtroyed by a lake of liquid fire and brimſtone, from mount *Veſuvius*, juſt in the manner we now find it; 50 foot deep in cinders, and aſhes.

When thy judgments, O God, are abroad, the inhabitants of the earth will learn righteouſneſs.

The Lord is the true God; he is the living God; the everlaſting King: At his wrath, the earth ſhall tremble, and the nations ſhall not be able to abide his indignation; ſays the prophet *Jeremiah*, x. 10.

God give us grace, that inſtead of theſe ſhort-lived, and unſatisfying pleaſures; inſtead of palaces and houſes here, ornamented in a ſumptuous and elegant *taſte*; which may perhaps be ſwept away, with their owners, in a moment; we may aſpire towards that heavenly city, which is above; whoſe foundations are not laid with hands, eternal in the heavens, *&c.*

THE PHILOSOPHY OF EARTHQUAKES, NATURAL and RELIGIOUS.

PART II,

> *Philoſophi ipſius, qui de ſua vi ac ſapientia unus omnia pene profitetur' eſt tamen quædam deſcriptio; ut is qui ſtudeat omnium rerum divinarum atque humanarum vim, naturam, cauſaſq; noſſe: & omnem bene vivendi rationem tenere, & perſequi; nomine hoc appelletur.*
>
> Cicero de Oratore.

By *WILLIAM STUKELEY*, M.D.
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LONDON:
Printed for A. and C. Corbett, at their *Correct State-Lottery-Office* over-againſt St. *Dunſtan*'s Church, *Fleetſtreet.*
M.DCC.LVI.

1756

PREFACE.

THIS diſcourſe is but a neceſſary conſequence of the preceding. The whole no other than an eſſay, toward inveſtigating the true nature of the wonderful appearance of an earthquake. And ſomething is done toward it, if only by eradicating an old error. In attaining the propoſed end, I have endeavoured to lay all the neceſſary circumſtances together, which to our great amazement we have ſeen and felt. That they may not be as ſoon forgotten, as they generally were, by the giddy multitude; equally thoughtleſs of what they knew to be paſt, as childiſhly fearful of an imaginary one, ſubſequent: for which there could not be the leaſt ground of apprehenſion. By ſober perſons it was, with great reaſon, thought a judicial infatuation, and as much to be wondered at, as an earthquake itſelf; a real panic. When a third part of this immenſe city ran out into the fields for half a cold night; alarmed with the ſilly prediction of a diſtempered fellow!

Nothing could tempt one to commemorate the follies of our cotemporaries, but the hope, it may be uſeful hereafter: and to ſhow the true cauſe of this ſenſeleſs terror; the want of a true ſenſe of *religion; and an univerſal degeneracy, and corruption of manners: begun by the great ones, and now propagated through all degrees to the loweſt: begun in this great city; and now advancing apace to every great town in the kingdom.*

'Tis from the great ones alone, that we can hope for a reformation: and that *by a ſtrict obſervance of the ſabbatical duty. Example, we know, governs the actions of mankind.* That *muſt reſtore the practice, and the influence of religion: which alone can prevent the dangers that infeſt every corner of our ſtreets; every road in the kingdom. We miſtake the point, and betray our ignorance in human nature, when we think, acts of parliament, laws, and executions will do it. They are very weak in compariſon of the impreſſions of religion, and conſcience: as all philoſophy both natural and religious, has hitherto thought, and known.*

TO

Martin Folkes, Eſq; LL. D.

Preſident of the Royal Society.

SINCE I had the honour to lay before the Society, in the ſpring, my thoughts upon earthquakes: we have had many further opportunities of reflecting upon that moſt awful, and hitherto unuſual appearance. An earthquake was felt at *Eaſtwell* in *Kent*, on *Monday*, *March* 12, and on *Sunday*, *March* 18, at *Portſmouth*, the *Iſle of Wight*, *Southampton*, and along the coaſt of *Suſſex*, the iſles of *Guernſey*, *Jerſey*. *April* 2, a ſmart earthquake at *Mancheſter*, *Liverpool*, *Taunton*, *Bath*, *Flint*, *Lancaſter*, *Wrexham*, reaching 40 miles north and ſouth: 70 miles eaſt and weſt. Since then at *Rome*, *Naples*, *Leghorn*; in the ſouth of *France*, and at *Pau* under the *Pyrenean* mountains: *Oporto*, at *S. Macaire* in *Guienne*, *Meſſina* in *Sicily*, *Munich* in *Bavaria*, &c. &c. ſo that the year 1750, may rather be called the year of earthquakes, than of jubilee. For ſince *February* laſt, when they began with us at *London*; as far as I can learn, they have appeared in many parts of *Europe*, *Aſia*, *Africa*, and *America*. And have likewiſe reviſited many counties in our own iſland, and at length, on the 30th of laſt *September* gave much the moſt extenſive ſhock, we have ſeen here in our days.

It may be well expected, that theſe frequent viſits, in themſelves ſo very extraordinary, to us ſo rare, and *that* in one year, ſhould keep up our attention: and as to my own part, induce one to reflect, on what I before offered concerning them; and be a ſufficient apology for the preſent paper.

We have been acquainted, by thoſe who remember it, that in the earthquake of *Nov.* 1703, which happened in *Lincolnſhire*, the weather was calm, cloſe, gloomy, warm, and dry; in a degree highly unuſual, at that ſeaſon. And thus it has been with us all the year. And from the numerous accounts we have received at the Royal Society, in the beginning and ending of the year; where any mention is made of the weather; they all agree in the like particular. Which is conſentaneous to what I remarked, as the conſtant forerunner of earthquakes; and what prepares the earth's ſurface, for the electrical ſtroke: which I aſſerted to be the cauſe of them.

In *May* laſt, we had a paper read at the Royal Society, concerning the ſecond earthquake felt by us at *London*, on the 8th of *March*. A ſhepherd belonging to Mr. Secretary *Fox* at *Kenſington* (the ſky being perfectly ſerene, and clear) was much ſurpriſed with a very extraordinary noiſe in the air, rolling over his head, as if cannon cloſe by. He likewiſe thought, that it came from the north-weſt, and went to the ſouth-eaſt: a motion quite contrary, to what muſt have been the caſe, if it were really of cannon. This noiſe paſſed ruſhing by him; and inſtantly he ſaw the ground (a dry, and ſolid ſpot) wave under him, like the face of the river. The tall trees of the avenue, where he was, nodded their tops very ſenſibly, and quivered like a ſhaken ſpear. The flock of ſheep immediately took fright, and ran all away together, as if dogs had purſued them. A great rookery in the place, were equally alarmed, and after an univerſal clangor, flew away; no leſs than if chaced by hawks.

I was likewiſe informed, that in the ſame earthquake, a great parcel of hens, and chickens, kept at that time in *Grays-inn-lane*, upon the ſhock, ran to the rooſt, affrighted. And the like was obſerved of pigeons. And in our laſt account of the earthquake from *Northampton*, 'tis remarked, that the birds in cages put their heads under their wings, as to hide themſelves.

June 21, at the Royal Society, Mr. *Jackſon*, potter at *Lambeth*, gave an account of ſome boats, cobles, and lighters in the river, at that time; the people in them ſeem'd to feel, as if a porpoiſe, or ſome great fiſh had heav'd and thump'd at the bottom of the veſſels. This is ſometimes the caſe of ſhips at ſea, when all is perfectly calm: which ſeems evidently owing to an electrical impreſſion on the water.

In the Whitehall Evening-poſt of *June* 23, we had a paragraph from *Venice*, that a terrible earthquake had been felt lately in the little rocky iſle of *Cerigo*, in the *Mediterranean*, ſouth of *Morea*. It threw down a great number of houſes; and above 2000 of the inhabitants were buried in the ruins.

Another earthquake about that time, happened in *Switzerland*; which ſplit a vaſt rocky mountain; and an old caſtle wall of an immenſe thickneſs.

All theſe circumſtances, and many more, confirmed me in my former opinion. But ſince then, theſe wonderful movements have ſtalk'd round the globe: and again been lately felt in our own iſland; happily for us, to the terror only of many thouſand people: beſide thoſe concuſſions of this ſort that appeared in the weſtern parts, in the more early time of the year.

I received a letter from my friend *Maurice Johnſon*, Eſq; the founder, and ſecretary of the Literary Society of *Spalding*: which has now ſubſiſted theſe 40 years. He acquaints me, that on *Thurſday*, 23d of *Auguſt* laſt, an earthquake was very ſenſibly felt there, about ſeven o'clock in the morning; throughout the whole town and neighbourhood; and many miles round; but that it chiefly ſpread itſelf northward, and ſouthward. He ſays, that for a fortnight before, the weather had been ſerene, mild, and calm. And one evening, there was a deep red *aurora auſtralis*, covering the cope of heaven, very terrible to behold. This ſame ſhock was felt at *Grantham*, *Stamford*, and *Milton* by *Peterborough*; and generally at all the intermediate places: and from *Spalding* it fled northward, along the ſea ſhore, to *Boſton*: thence up *Boſton* river, to *Lincoln*.

Since then, I had a letter from Mr. Alderman *Taylor* of *Stamford*, giving an account of another earthquake, that happened there, *September* 30, at 36 minutes after twelve o'clock at noon. He deſcribes it thus. They were ſuddenly ſurpriſed with an uncommon noiſe in the air, like the rolling of large carriages in the ſtreets, for about 20 ſeconds. At the ſame inſtant they felt a great ſhake, or ſnap, as he calls it; inſomuch that it ſenſibly ſhook a punch-bowl, which was in his parlour, and made it ring. He ſays, it was perceiv'd of moſt of the people of *Stamford,* who generally ran out of their houſes. At *Oakham* the chief town of *Rutland,* the congregation ran out of the church whilſt the preacher was in the pulpit. All the towns round *Stamford,* were ſenſible of it: and at *Peterborough,* down to *Wiſbech.*

Thus far the Alderman. But we have had many advices from all hands, at the firſt, and ſecond meetings of the Royal Society, for the winter-ſeaſon; with further particulars relating to this great concuſſion. That it was felt at the ſame time, at *Rugby* in *Warwickſhire,* and reached to *Warwick,* at *Lutterworth,* in *Leiceſterſhire:* at *Leiceſter,* and round about. It extended itſelf to *Coventry, Derby, Nottingham, Newark;* then came eaſtward to *Harborough, Towceſter, Northampton, Rowel, Kettering, Wellingborough, Oundle,* in *Northamptonſhire; Uppingham, Oakham,* in *Rutland; Stamford, Bourn, Grantham, Spalding, Boſton,* and to *Lincoln* in *Lincolnſhire; Holbech,* and all *Holland* in that county. *Peterborough, Wiſbech,* in the iſle of *Ely;* together with all the intermediate, and adjacent places. Then it paſſed over the whole breadth of *Ely* fen: was felt at *Mildenhall,* and reach'd to *Calford* by *Bury* in *Suffolk,* and the country thereabouts; of which we had notice from lady *Cornwallis.* An extent from *Warwick* to *Bury* of about 100 miles in length; and generally ſpeaking, 40 miles in breadth. And this vaſt ſpace was pervaded by this amazing motion, as far as we can get any ſatisfaction, in the ſame inſtant of time. They deſcribe it, that the houſes totter'd, and ſeem'd to heave up, and down: though it laſted but a few ſeconds. It was attended with a ruſhing noiſe, as if the houſes were falling, and people were univerſally ſo affrighted, as to run out; imagining that their own, or their neighbours houſes were tumbling on their heads. In the villages around, the people being generally at divine ſervice, were much alarm'd: both with the noiſe, which exceeded all the thunder they had ever heard, beyond compare: and with the great ſhock accompanying; which was like ſomewhat, as they imagined, that ruſh'd againſt the church-walls, and roof. Some thinking the pillars crack'd, many that the beams of the roof were disjointed; and all, that the whole was falling. And happy were they that could get out firſt. Many people fancied, that neſts of drawers, and cabinets, or the like heavy things, were fallen down above ſtairs: or that chimnies had broke through the roof of the houſe: or that ſome perſons fell down ſtairs: and the like. Some perceived the crackling of inward wainſcots or partitions: as Dr. *Mortimer* and I obſerv'd in our firſt and ſecond ſhocks at *London.* A few ſlates, tiles, and parts of chimnies fell from ſome houſes: pewter, china, glaſſes, and braſs from ſhelves. A clock bell, chamber bell ſome time ſtruck: windows univerſally rattled, and the like circumſtances of tremor.

In regard to circumſtances, they were pretty ſimilar throughout. Many people ſitting in their chairs relate, that they and their chairs were ſeveral times ſenſibly lifted up and ſet down again. A ſtack of chimnies were thrown down in *College-lane*; a place retaining the memory of a ſort of univerſity once beginning at *Northampton.* The windows of houſes rattled throughout the whole town: but no miſchief done: in general it was frightful, and innocuous.

They fancied there, the motion of it, as they expreſſed it, to be eaſtward. In ſtreets that run north and ſouth, the houſes on the eaſt ſide of the way, were moſt affected. And Dr. *Stonehouſe*'s dwelling, the ſtrongeſt in the town, was moſt ſenſibly ſhaken. So it was likewiſe obſerved, that churches were moſt ſubject to its violence. They thought too, that the motion ſeemed rather horizontal, or lateral, than upward. Some counted the pulſes diſtinctly, to the number of four: that the ſecond, and third pulſes were ſtronger, than the firſt, and fourth.

From all theſe various accounts, there was no ſulphureous ſmell, or eruption; no fiſſures in the ground perceived. Yet ſeveral people were ſick upon it: infinite numbers terribly affrighted, and as ſoon forgot the impreſſion of it; or talk'd of it in a merry ſtrain; as commonly with us at *London*. So little are the vulgar affected, without ſomething very ſenſible; and ſo ſoon is the ſenſe of it worn out!

It was more evidently perceived, by people ſtanding; moſt, by thoſe that were ſitting: leaſt, by ſuch as were walking: and in upper ſtories of houſes, more than in lower; or in cellars. Some coming down ſtairs, were in danger of being thrown forwards. Several ſitting in a chair, and hearing the hollow thundering noiſe, and thinking it was a coach paſſing by; when they attempted to get up, to ſee what it was, they were thrown back again in their chair. Some heard the wainſcot crackle. Some ſitting in their chairs leaning forwards, were thrown down on their hands and knees. Some people heard the noiſe without feeling the ſhock: others felt the ſhock without hearing the noiſe. Some in a ſtanding poſture, were forced to lay hold on a table, to keep themſelves from falling.

It was particularly remarked (as before obſerved) that birds in cages were ſenſibly affrighted; thruſting their heads under their wings. Mrs. *Allicock* of *Loddington*, *Northamptonſhire*, a lady in child-bed, was ſo affected, that it cauſed her death. Mrs. *Hardy*, another lady in the ſame circumſtance, and in the ſame county, likewiſe expired upon it. Some people felt a ſudden ſhortneſs of breath, that they were forc'd to go out into the open air, it ſo affected the pulmonary nerves. Many were taken with head-achs, and other ſickneſſes.

Theſe are, in general, the circumſtances and obſervations made, at the time of theſe earthquakes; when we recollect ourſelves, after the ſuddeneſs, and fright. Give me leave to make the following remarks therefrom.

1ſt. As far as we can poſſibly learn, where no one can be prepar'd, at different places, by time keepers; this mighty concuſſion was felt preciſely at the ſame inſtant of time; being about half an hour after twelve at noon. This, I preſume, cannot be accounted for, by any natural power, but by that of an electrical vibration; which, we know, acts inſtantaneouſly.

2dly, Let us reflect on the vaſt extent of this trembling, 100 miles in length, 40 in breadth, which amounts to 4000 ſquare miles in ſurface. That this ſhould be put into ſuch an agitation, in one moment of time, is ſuch a prodigy; as we ſhould never believe, or conceive, did we not know it to be fact, from our own ſenſes. But if we look for a ſolution of it, we cannot think, any natural power is equal to it, but that of electricity; which acknowledges no ſenſible tranſition of time; no bounds.

3ly, We obſerve the vulgar ſolution of ſubterraneous eruptions receives no countenance, from all that was ſeen, or felt, during theſe earthquakes. It would be very hard to imagine, how any ſuch thing could ſo ſuddenly, and inſtantaneouſly operate, thro' this vaſt ſpace; and *that* in ſo ſimilar, and tender a manner over the whole, thro' ſo great a variety, as well as extent of country; as to do no miſchief. A philoſophical inquirer in *Northamptonſhire*, who had his eye particularly on this point, takes notice, there were not any fiſſures in the ground; any ſulphureous ſmells, or eruptions any where perceiv'd; ſo as to favour internal convulſions of the earth. The reverend Mr. *Nixon* of *Higham*, and Mr. *Smith*, in his letter from *Peterborough* take notice, that they could not learn, there were any ſort of eruptions out of the earth, any where: no ſmoke, vapor, or ſmell? tho' they made ſufficient inquiry about that circumſtance, according to particular direction. Yet we learn from a letter at *Uppingham* in *Rutland*, that a plaiſter floor became crack'd thereby. Theſe kind of floors are frequent in this country; what we call *ſtucco* in *London*: and it gives us a good notion of the undulatory vibration, produc'd by an earthquake; which ſome have compar'd to that of a muſical ſtring: others to that of a dog, or a horſe ſhaking themſelves, when they come out of the water. This laſt compariſon would have pleaſed ſome of the ancients, who would needs fancy, that the globe of the earth was a great animal. *Plato*, *Plutarch*, and others, had ſuch kind of ſentiments. Whence one may imagine, that they would conceive an earthquake to be, as when a horſe ſhakes a part of his ſkin, upon a fly touching him. Some of our correſpondents expreſs the motion of an earthquake to be like a boat lifted up by one wave, let down by another.

4ly, The former earthquake that happen'd at *Grantham*, *Spalding*, *Stamford*, (which towns lie in a triangle) took up a ſpace which may, in groſs, be accounted a circle of 30 miles diameter: the center of which is that great moraſs, called *Deeping-fen*. This comprehends 15 miles of that 30, in diameter; and where probably,

bably, the electrical impreſſion was firſt made. Much the major part of *Deeping-fen* is under water in the winter time; underneath 'tis a perfect bog. Now it is very obvious, how little favorable ſuch ground is, for ſubterraneous fires.

In the ſecond earthquake, not only this country was affected again, but likewiſe a much larger ſpace of the ſame ſort of fenny ground, rather worſe than the former: all *Donnington-fen*, *Deeping-fen*, *Croyland-fen*, *Thorney-fen*, *Whitleſea-fen*, and *Bedford* level, and the whole extent of *Ely-fen*, under various denominations. This country, under the turf, abounds with ſubterraneous timber of all ſorts; fir, oak and bruſh-wood: and ſtags horns. Now and then they find a quantity of hazel nuts, crouded together on an heap. I have ſome of them. This is a matter common to all boggy ground over the whole globe. Such things are the ruins of the *antediluvian* world, waſhed down from the high country where they grew, were here lodg'd upon the ſubſiding of the waters, and by time are o'ergrown with the preſent turf. They that ſeek for any other ſolution of this affair, than the univerſal *Noachian* deluge, want to account for a general effect, by a partial cauſe: and ſhut their eyes, both to the plain hiſtory of this matter; and to the infinite, notorious demonſtrations of it, from foſſil appearances.

5ly, All this country, tho' underneath 'tis a watry bog, yet thro' this whole ſummer, and autumnal ſeaſon (as they can have no natural ſprings in ſuch a level) the drought has been ſo great on the ſuperficies, that the inhabitants were obliged every day, to drive their cattle ſeveral miles, for watering. The drought was greater, than has been known in the memory of any one living. This ſhows how fit the dry ſurface was, for an electrical vibration. And we learn from hence, this important particular, that it reaches but very little below the earth's ſurface.

Mr. *Johnſon*, in another letter which he wrote to me concerning the ſecond earthquake obſerved at *Spalding*; ſays upon this occaſion, he was obliged to ſcour his canal, and deepen it: that they came to a white quickſand; which afforded to all the neighbourhood, excellent water in plenty.

In the gravelly ſoil of *London*; and where the two ſhocks were felt by us, in the beginning of the year; we know there is not a houſe in the whole extent of this vaſt city, and all aronnd it, but a ſpring of water is ready, upon digging a well. Whence we have much reaſon to believe, that the interior of the earth, is like a ſponge ſoak'd in water. So that the only dry part is the ſuperficies, which is the object, and the ſubject of that electric vibration; wherein, according to my ſentiments, an earthquake conſiſts.

This ſhews the miſtake of the ancients, who fancying that earthquakes proceeded from ſubteraneous eruptions, built their prodigious temple of *Diana* at *Epheſus*, upon a boggy ground, to prevent ſuch a diſaſter. The marſhy part of *Lincolnſhire*, being my native country, the adjacent fen, together with that of the iſle of *Ely*, I have been perfectly acquainted with; from one end to the other, ever ſince I knew any thing. This vaſt extent of fenny level, from near *Cambridge* in the ſouth, to near *Horncaſtle* in the north, is 70 miles in length. And when I perceiv'd, that it was, in whole, or in part, ſhaken by both the laſt earthquakes: I could not but ſee, that it was no leſs than a demonſtration againſt the old notion of their cauſe.

6ly, Earthquakes are truly moſt violent in a rocky country: becauſe the ſhock is proportionate to the ſolidity of the matter electrify'd. So that rocks, cliffs, quarries, old caſtle walls, and ſtrong buildings, are moſt obnoxious to the concuſſion. The iſle of *Cerigo* was more liable, and more rudely handled by the late earthquake; both becauſe it was an iſle, and becauſe it was rocky. So we muſt ſay of the late earthquake in *Switzerland*, that ſplit the mountain, and the old caſtle wall. Whence Mr. *Johnſon* in his ſecond letter ſays, it crack'd a very ſtrong brick-houſe in *Goſberton* by *Spalding*. Dr. *Doderidge* obſerves from *Northampton*, that Dr. *Stonehouſe*'s dwelling being a very ſtrong one, was moſt ſenſibly ſhaken. And throughout the whole compaſs of this great earthquake, we find, both the noiſe, the ſhock, and the terror was greateſt at the churches, whoſe walls and bulk made more reſiſtance than houſes. And generally ſpeaking, the churches throughout this whole extent have very fair and large towers, and very many remarkable ſpires all of good ſtone, which no doubt quivered very much at top, if we could have diſcern'd it. This ſame vibration impreſſed on the water, meeting with the ſolid of the bottom of ſhips, and lighters, gives that thump felt thereon; juſt as in common electrifying, we feel the ſtroke upon the joints of our limbs chiefly. Yet of the millions of ordinary houſes, over which it paſſed, not one fell. A conſideration which ſufficiently points out to us, what ſort of a motion this was not, what ſort of a motion it was, and whence derived; not a convulſion of the bowels of the earth, but an uniform vibration or undulation of its ſurface, aptly thought like that of a muſical ſtring: or what we put a drinking glaſs into, by rubbing one's finger over the edge; which yet brought to a certain pitch, breaks the glaſs; undoubtedly an electric repulſion of parts. And from this remarkable ſimilarity in the appearance of earthquakes we gather an invincible argument againſt the old opinion of their cauſe; for the tumult of ſubterraneous eruptions can have no poſſible place herein.

7ly, We find from all accounts, ancient and modern, that the weather preceding theſe ſhocks, was mild, warm, dry, ſerene, clear, froſty: what notoriouſly favours all our electrical experiments. This is particularly obſerv'd by Mr. *Johnſon* and Mr. *Smith*, and other accounts. In the extenſive ſhock of *Sunday March* 18, along the *Suſſex* coaſt, they take notice from *Portſmouth*, that the day was ſerene, warm, and dry, and that a ſhower of rain fell immediately before the ſhock. Mr. *Bowman* of *Moulſey* obſerv'd a ſhock there on *May* 24 laſt, and ſays, the air was perfectly ſerene, and clear. We very well know, that generally, all laſt winter, ſpring, ſummer, and autumn, have been moſt remarkably of this kind of weather; more ſo, than has been obſerv'd in our memory; and have had all thoſe requiſites, appearances, and preparations, that notoriouſly cauſe electricity, that promote it, or that are the effects of it.

8ly, We find the blood-red *auſtralis aurora* preceding at *Spalding*, as with us at *London*. At the time of the earthquake at *Mancheſter* this year, it accompanied it. And this year has been more remarkable than any for fire-balls, ſtorms, wind, thunder, lightnings, and coruſcations, almoſt throughout all *England*. A large ball of fire, with a long fiery tail on *July* 22, that paſſed over great part of *England* northward. Another ſeen over *London*, paſſing from weſt to eaſt, in *october*. Coruſcations were ſeen juſt before that extenſive ſhock of 70 miles long felt from *Lancaſter* to *Wrexham*, on *april* 2, laſt. Fire-balls more than one were ſeen in *Rutland*, and *Lincolnſhire* : and particularly obſerv'd. And Mr. *Smith* from *Peterborough* writes, that a fire-ball was ſeen the morning of the earthquake, in the upper part of *Northamptonſhire*. All theſe kind of meteors are rightly judg'd to proceed from a ſtate of electricity in the earth and atmoſphere ; and how far they are actually concerned in cauſing earthquakes, time, and accurate obſervation muſt inform us.

9ly, Mr. *Johnſon* in both his letters to me, on the firſt and ſecond earthquakes, at *Spalding*, remarks particularly, of their effects being moſtly ſpread to the north and ſouth, and eſpecially felt on the ſea coaſt. We may obſerve, that ſuch is the direction of *Spalding* river, which both conducts, and ſtrengthens the electric vibration: conveying it along the ſea-ſhore thence, up to *Boſton* channel; and ſo up *Boſton* river to *Lincoln*, as we diſcern, by caſting our eye on a map.

We obſerve further, that the main of this ſecond earthquake diſplay'd its effects along, and between the two rivers, *Wolland* and *Avon*: and *that* from their very origins, down to their fall into the ſea. It likewiſe reach'd the river *Witham*, which directed the electric ſtream that way too, to *Lincoln*. For which reaſon, as there meeting the ſame coming from *Boſton*, the ſhock was moſt ſenſibly felt. It reach'd likewiſe to the *Trent* at *Nottingham*, which convey'd it to *Newark*.

The firſt electrical ſtroke ſeems to have been made on the high ground above *Daventry*, in *Northamptonſhire*; where the *Roman* camps are, made by *P. Oſtorius* the propraetor. From thence it deſcended chiefly eaſtward, and along the river *Welland*, from *Harborough* to *Stamford*, *Spalding*, the ſea: and along the river *Avon*, or *Nen*, to *Northampton*, *Peterborough*, *Wisbech* to the ſea. It ſpread itſelf all over the vaſt level of the iſle of *Ely*; further'd by very many canals, and rivers, natural, and artificial, made for drainage. It was ſtill conducted eaſtward up *Mildenhall* river, in *Suffolk,* to *Bury*, and the parts adjacent. All this affair duly conſider'd, is a confirmation of the docrine I advanc'd on this ſubject.

10ly, I apprehend, it was not the noiſe in the air, as of many cannon let off at once, preceding the earthquake, that ſo much affrighted people, or affected the ſheep, the rookery at *Kenſington*, the hen and chickens in *Gray*'s-*inn-lane*, the pigeons. It could not be barely the ſuperficial movement of the earth, that diſturb'd them all at once. I judge it to be the *effect* of electricity, ſomewhat like what cauſes ſea ſickneſs; ſuch a ſort of motion, as we are not accuſtomed to. So the earthquake affects all thoſe of weak nerves, or that have nervous complaints; obnoxious to hyſterics, colics, rheumatic pains in their joints; ſeveral women were ſeized with violent head-achs, before both the ſhocks we felt in *London*. It was this that gave the people a ſhortneſs of breath. Mr. *Smith* from *Peterborough* ſpeaks of a perſon that found himſelf very ſick upon it. This made the dog run whining about the room, ſeeking to get out: this made the fiſhes leap up in the pond at *Southwark*; like as the experiment of electrifying the fiſhes: it makes them ſick. And this cauſes the birds in cages to hide their heads under their wings, becauſe they cannot fly away. Which is commonly obſerv'd of them in *Italy*, and countries, where earthquakes are more frequent.

11ly, I obſerve, the ſhepherd at *Kenſington* thought the motion of the earthquake, and the ſound, was from the north-weſt to ſouth-eaſt: the like Mr. *W. Smith* from *Peterborough*. On the contrary, Mr. *Byfield* the ſcarlet-dyer in *Southwark*, thought the noiſe came from the river below bridge, and went toward *Weſtminſter*; where it rattled ſo, that he did not doubt, but that the abbey church was beaten down.

Dr. *Parſons* took pains to find out the way of the motion of the earthquake, from the different poſition of people's beds; but from the contradictory anſwers given, he cou'd not obtain any ſatisfaction, as to that point. All this, and what was obſerv'd from *Northampton*, of the motion being thought by ſome, to be upward and downward; by others rather horizontal, or lateral: the counting the pulſes, and the like, only points out to us the prodigious celerity, and the vibratory ſpecies of the motion of an earthquake. But far, very far is this from being owing to the tumultuous ebullition, the irregular hurry of ſubterraneous exploſions.

12ly, How the atmoſphere, and earth, are put into that electric and vibratory ſtate, which prepares them to give, or receive the ſnap, and the ſhock, which we call an earthquake; what it is, that immediately produces it, we cannot ſay: any more than we can define, what is the cauſe of magnetiſm, or of gravitation; or how muſcular motion is perform'd, or a thouſand other ſecrets in nature.

We ſeem to know, that the author of the world has diſſeminated ethereal fire, thro' all matter, by which theſe great operations are brought about. This is the ſubtil fluid of Sir *Iſaac Newton*, pervading all things: the occult fire diffuſed thro' the univerſe, according to *Marſilius Ficinus* the platonic philoſopher, on the *Timeus* of his maſter. All the Platoniſts inſiſt on an occult fire paſſing thro', and agitating all ſubſtance, by its vigorous and expanſive motion.

Before them, *Hippocrates* writes in the ſame ſenſe, *I. de victûs ratione*, that this fire moves all in all. This ethereal fire is one of the four elements of the ancients. It lies latent, and diſperſed thro' all the other three, and quieſcent: till collected into a quantity, that overbalances the circumjacent; like the air crouded into a tempeſt: or till it is excited, by any proper motion.

This fire gives elaſticity: and elaſticity or vibration is the mother of electricity. We don't ſo much wonder at phoſphorus ariſing from animal ſubſtances; for this fire is in water, and betrays itſelf to our ſenſes, in ſalt water. Many a time when I have paſſed the *Lincolnſhire* waſhes, in the night time; the horſe has ſeem'd to tread in liquid flames. The ſame appearance is oft at the keel of a ſhip. Fire exiſts in water, ſays *Pliny*, as well as in human bodies. *nat. hiſt.* II. 107. Loaf ſugar beaten in the dark is luminous. Many vegetables, as indian cane, and rotten wood the like, as *Bartholin* largely recites, *de luce hominum* c. 4. All electric bodies have this privilege: that is, they more eaſily diſcover it. Amber, gum lac, naptha, bitumens, ſome precious ſtones. My old friend Mr. *Stephen Gray* the father and great propagator of electricity, ſhow'd me experiments therein, in the year 1705, then at *Corpus Chriſti* college in *Cambridge*. Afterward in 1719, he ſhow'd by experiments before the Royal Society, that paper, ribbands, ſilk, ſattin, cloth, ſhavings, linen, goldbeaters ſkin, and in ſhort, almoſt all kind of ſubſtances diſcover electrical ſparks of fire in the dark: eſpecially when well warm'd before the fire, or in a cold, dry, nitrous air, and in a room where there is no company. This ſame quality is found *in vacuo*, as Dr. *Deſaguliers* ſhow'd before the Royal Society, *march* 31, 1720. He took an exhauſted glaſs globe, and cauſed it to be turn'd round violently, in an engine: by rubbing the hand upon it, it was illuminated within ſide, with purple ſtreams. This gave foreigners the idea of uſing a glaſs globe, in electrical experiments.

The operation of the ethereal fire is various, nay, infinite, according to its quantity, and degree of incitement, progreſs, hindrance, or furtherance. One degree keeps water fluid, ſays the learned biſhop of *Cloyne*: another turns it into elaſtic air, and air itſelf ſeems nothing elſe, but vapors, and exhalations render'd elaſtic, by this fire.

This ſame fire permeates, and dwells in all bodies; even diamond, flint and ſteel. Its particles attract with the greateſt force, when approximated. Again, when united, they fly aſunder, with the greateſt force, and celerity; it reſiſts nothing quieſcent, but when put into motion, it diſdains all reſiſtance. All this is according to the laws preſcrib'd by the ſovereign architect. This is the life and ſoul of action, and reaction, in the univerſe. Thus has the great author provided againſt the native ſluggiſhneſs of matter! light, or fire in animals, is what we call the animal ſpirits; and is the author of life, and motion. But we know not the immediate mode of muſcular motion; any more than how, in inanimate matter, it cauſes the vibrations of an earthquake.

Of this fire, the excellent *Manilius* thus writes, who liv'd in the time of *Auguſtus*.

Aſtronom. I.

Sunt autem cunctis permiſti partibus ignes;
Qui gravidas habitant fabricantes fulmina nubes:
Et penetrant terras, Ætnamq; imitantur Olympo:
Et calidas reddunt ipſis in fontibus undas.
Ac ſilice in duro, viridiq; in cortice ſedem
Inveniunt; cum ſilva ſibi colliſa crematur.
Ignibus uſq; adeo natura eſt omnis abundans!

Which may thus be engliſh'd.

Fire univerſal nature traverſes.
It makes the thunderbolt in tumid clouds:
In dire Vulcano's penetrates the earth:
And ſends the boiling water from its ſprings.
In hardeſt flint, and ſofteſt wood it dwells:
Which by colliſion ſhows itſelf in flame.
With fire ſo pregnant is all nature found!

13ly, The great queſtion then with us, is how the ſurface of the earth is put into that vibratory and electric ſtate, by heat and drineſs? we muſt needs acquit the internal of the earth from the charge of theſe ſuperficial concuſſions.

cuſſions. How then is the ethereal fire crouded together, or excited, ſo as to cauſe them; ſeeing in our ordinary electrical experiments, we make uſe of friction?

But that friction alone does not excite electricity, we know from the obvious experiment of flint and ſteel, where the ſuddenneſs of the ſtroke, and hardneſs of the matter does it. Another method of exciting it, is the letting off a number of great guns, which ſo crouds the ethereal fire together, as to electrify glaſs windows; obſerv'd by my friend the reverend Dr. *Stephen Hales*. The *aurora borealis*, *auſtralis*, all kind of coruſcations, meteors, lightning, thunder, fire-balls are the effects, and may reciprocally be the cauſe of electricity; but how in particular we know not. Come we to the animal world, we muſt needs aſſert, that all motion voluntary, involuntary, generation, even life itſelf: all the operations of the vegetable kingdom, and an infinity more of nature's works, are owing to the activity of this electric fire, the very ſoul of the material world. And in my opinion, 'tis this alone, that ſolves the famous queſtion, ſo much agitated with the writers in medicine, about the heat of the blood. How theſe, how earthquakes are begun, propagated, we are yet to ſeek.

We may readily enough preſume, that the contact between the electric, and the non-electric, which gives the ſnap, and the ſhock, muſt come from without, from the atmoſphere. Perhaps by ſome meteor that crouds the ethereal fire together: which then flies off with that immenſe force that cauſes the earthquake. In the point of contact on the earth's ſurface, the ſame thing is done, perhaps, another time, by a ſhower of rain. Our thoughts upon this matter muſt needs be as immature, as they are novel. But we may readily conclude, that tho' the original ſtroke comes from the atmoſphere, yet the atmoſphere has no further concern in it: no aereal power, or change therein, can propagate itſelf ſo inſtantaneouſly, over ſo vaſt a ſurface, as 4000 miles ſquare. Therefore the impetuous ruſhing noiſe in the air, accompanying the ſhock, is the effect, and not the cauſe. And all this is ſtrongly confirmed by this obſervation, that the barometer and thermometer received no change upon the earthquakes.

But ſurely, there is not a heart of fleſh that is not affected with ſo ſtupendous a concuſſion! let a man eſtimate his own power, with that which cauſes an earthquake; and he will be perſuaded, that ſomewhat more than ordinary is intended by ſo rare and wonderful a motion. That great genius *Hippocrates*, makes the whole of the animal œconomy to be adminiſtred, by what we call nature. And nature alone, ſays he, ſuffices for all things, to animals: ſhe *knows* herſelf, and what is neceſſary for them. We muſt extend this thought to the inanimate world. And can we deny then, that he here means a conſcious and intelligent nature, that preſides over, and directs all things, moves the ethereal ſpirit or fire, that moves all things: a divine neceſſity, but a voluntary agent, who gives the commanding nod, to what we commonly call nature; the chief inſtrument in the moſt important operations of the vaſt machine, as well as in the ordinary ones, particularly the human one: adminiſtring the whole œconomy (as he ſays) without noiſe, unſeen, unfelt. And this leads us,

14ly, Laſtly, in regard to the ſpiritual uſe we ought to make of theſe extraordinary *phænomena*, or of our inquiries about them, I ſhall firſt obſerve, that we find abroad, ſeveral of theſe earthquakes this year have been very fatal. In the laſt we read of, at *Philippopoli* in *Thrace*, the whole city was deſtroyed, above 4000 inhabitants killed. At home, where above half a ſcore ſeparate concuſſions have been felt, there has not been one houſe thrown down, one life loſt. This ought to inſpire us with a very ſerious reflection about them; nor is it altogether unworthy of our remark, that they began with us in *London*, in *February* laſt: and after viſiting the circle of the globe, at preſent, end with us.

2dly, We may obſerve, that if we did but read the works of *Hippocrates*, *Plato* and his followers; of *Tully*, *Galen*, and the like ethic writers of antiquity; whilſt we ſtudy, and try the affections of matter; we ſhould improve in philoſophy, properly ſpeaking: we ſhould lift up our minds from theſe earthly wonders, and diſcern the celeſtial admonitions, they preſent to us.

The original meaning of the word philoſophy, was rightly apply'd to moral wiſdom. We who have advanced both the natural, and moral, ſhould, as the ancients did, join them both together. By this means, we gather, the truth of the higheſt, and moſt excellent philoſophy, to be found in thoſe volumes of firſt antiquity, which we call ſacred: and which, it is our peculiar, and ineſtimable happineſs to poſſeſs. We ſhould adore that divine light, which they hold forth to us. Eſpecially in a country, where the principles of true religion are open, and undiſguiſed: where the eſtabliſhed profeſſion of it is rational, noble, and lovely: worthy of the moral governor of the world; fit for him to enjoin: for us to practiſe, with pleaſure and effect.

November 7, 1750.

W. STUKELEY.

Read at the Royal Society, *December* 6.

THE PHILOSOPHY OF EARTHQUAKES, NATURAL and RELIGIOUS.

PART III.

Opinionum commenta delet dies, naturæ judicia confirmat. Cic.

By *WILLIAM STUKELEY*, M.D.
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LONDON:
Printed for A. and C. Corbett, at their *Correct State Lottery-Office* over-againſt St. *Dunſtan's* Church, *Fleetſtreet.*

M.DCC.LVI.

To the Right Honourable

The Earl of MACCLESFIELD,

President of the Royal Society.

THE amazing *phænomenon* of *November* 1, 1755, being *All Saints* day, will prove a moſt memorable point in the current of time, as long as the revolution of our globe, meaſures it. This has induced me again to treat on the ſubject; a regard due to ſo remarkable events in our own days, our own country, among others.

Though the mere hiſtory thereof merits to be recorded, and ſomewhat of their manner; as far as they ſeem to lead us to the philoſophy of theſe prodigious movements of nature: yet I was more particularly induced thereto, when I could not help perceiving, that they all pointed out the cauſe, which I had aſſigned, five years ago.

I have been attentive to this argument, upon every occaſion that has offered from home, or abroad; and this laſt of 1 *November*, has in every circumſtance ſo confirm'd it, that I hope, it will not be unſeaſonable to add this third part to my former. We cannot treat on this awful ſubject, without a regard to religion, never to be ſeparated from ſo extraordinary a power in nature. A power wherein all the four elements are engaged; not in a mutual oppoſition, and friendly ſtrife; for in that elemental combination, the operations of nature in their uſual courſe are carried on: but in a concurrence tumultuous, an engagement abſolutely hoſtile.

Theſe unbridled ſtorms require the hand of providence to overrule them, to rebate, to direct. And this before us appears to be one of the greateſt commemorated in hiſtory, like to that of *Tiberius*'s time, when 13 noble cities of *Aſia minor* were totally deſtroyed, as now *Liſbon*, *St. Ubes*, and ſome more. They were not ſwallowed up, according to the vulgar notion, and the vulgar way of expreſſion, on theſe occaſions, but ſhaken into an heap of rubbiſh, as now *Liſbon*, &c. They were rebuilt on the ſame foundations; this happened ten years before our Saviour's baptiſm, and entry on his public miniſtry. There appeared ſeveral more of theſe tremors, in the *Roman* empire, about this time; but *Aſia minor* was a very conſpicuous point, and prov'd a moſt fruitful ſeed-plot of the chriſtian church in its infancy, where were the ſeven flouriſhing churches, to which St. *John* addreſſes the apocalypſe. A judgment this very proper to reduce the inhabitants to ſuch a ſerious frame of mind, as is agreeable to the views of religion. And we may obſerve, the prophets often ſpeak of ſuch, as preludes to the advent of Meſſiah. Thus *Iſaiah* xiii. 6. “ *Howl ye, the day of the Lord is at hand, it ſhall* “ *come, as a deſtruction from the Almighty.* 13. “ *Therefore I will ſhake the heavens and the earth,* “ &c.” repeated in *Joel* iii. 14. very remarkably. *Haggai* ii. 6, 7.

And theſe kind of portents, at all times are ſeaſonable, to recal Chriſtians from the riotous exceſſes, and love of pleaſure, which is the general ſourſe of the evils in this ſtate of things; that want to be corrected, that diſſipate all reflection, promote a neglect of that ſoul of religion; the ſabbatic duty, that corrupt the morals of mankind, and prevent the good example, which the great ones ought to hold forth, to the inferior part of the world: without which, all advice, and inſtruction is fruitleſs.

Hence it is, that Chriſtianity, intended, and incomparably well ſuited, to make us happy here, as well as hereafter; to render the world even a kind of paradiſe, is defeated in its purpoſe. For did we intimately conſider the matter, it is *that* alone, which gives true felicity in human affairs, even in our preſent ſtate.

In my firſt paper on this ſubject, I recited the general appearances of earthquakes, in the form of axioms; as very helpful in the inveſtigation of cauſes. Its now uſeful to repeat them, and from later obſervations ſomewhat improved, and enlarged, thus:

CIRCUMSTANCES.

I. That earthquakes always happen in calm, warm, dry, ſultry ſeaſons; or in a dry, froſty air.

II. That they are felt at ſea, on lakes, rivers, even in the main ocean, as well as on land: and at that time the ſea and waters are calm.

III. That earthquakes differ very much in magnitude. Some ſhake a very large tract of country, at the ſame inſtant of time: ſometime extend to many countries, ſeparated by mountains, lakes, ſeas, the ocean.

IV. That earthquakes differ much in the quantity of their vibratory motion; whence in ſome, though largely extended, they are innocuous: in others, both ſmall and large, they lay all in ruins.

V. That a hollow thundering noiſe accompanies them, or rather ſeems to precede the ſhock; which rolls in the air, like the noiſe of cannon.

VI. That they are felt more ſenſibly in the upper ſtory of houſes, than in the lower; on lofty buildings, ſteeples, *Turkiſh* minorets, and the like.

VII. That the ſhock is more violent upon more ſolid buildings, churches, caſtles, towers, and ſtone-houſes, than on thoſe of ſlighter materials.

VIII. That many people find themſelves ſick at ſtomach, with head-achs, *vertigo*'s, pains in their joints, and the like: which ſometimes laſt for the day after, or longer.

IX. That earthquakes generally happen to great towns, and cities: and more particularly to thoſe that are ſituate on the ſea, bays, and great rivers.

X. That earthquakes do not cauſe any damage to ſprings, and fountains: but the water in wells becomes foul for ſome time.

XI. That they are frequent in the neighbourhood of a vulcano.

XII. That earthquakes often ſhake rocks, mountains, cliffs hanging over the ſea, ſplit them from top to bottom, throw down great parcels of them.

XIII. That fowls domeſtic, birds in the air, cattle in the fields are affrighted, fiſhes in the water much affected therewith.

XIV. That chandeliers in churches vibrate; bells in ſteeples and houſes ring.

XV. That ſometime, the hollow, thundering noiſe accompanying an earthquake, is heard without any motion on the earth.

XVI. That an impreſſion or agitation in the water, is ſometime perceiv'd, without a motion on the earth: at other times accompanies it.

XVII. That fire balls and meteors are frequently obſerv'd then.

XVIII. That the ſurface of the earth is chiefly, and moſt frequently, the object of earthquakes.

XIX. That earthquakes affect to run up rivers and ſea-ſhores, and act more violently on places neighbouring thereto.

A due reflection on theſe particulars muſt lead us to the real cauſe, electricity, no other than what cauſes thunder and lightning, meteors, coruſcations, *aurora*'s, and the like aerial appearances.

The enſuing paper I had drawn up in part, to be laid before the Royal Society, but was continually interrupted by new accounts every poſt. From the whole I extracted what was chiefly requiſite for the purpoſe of illuſtrating our main doctrine.

Being at *Stamford*, in the beginning of *Auguſt* laſt, I heard from all hands, of the earthquake perceived there, and round the country; on *Friday* the firſt of that month, at ſeven in the morning.

They did not ſcruple there, calling it an earthquake: though no movement on the earth was obſerved, only the horrible noiſe above head, always accompanying an earthquake.

After my return to town, I received a letter from our ingenious correſpondent Mr. *Thomas Barker*, of *Lyndon* in *Rutland*, giving a very preciſe rehearſal of what he obſerved therein. Whilſt I was tranſcribing the particulars, in order to lay them before the Society, we have had ſuch numerous, and continually repeated accounts of theſe dire diſaſters, well nigh thro' all *Europe*, happening this year, that I could not avoid making mention of them all. But as theſe bare relations may be accounted only matter of hiſtory, I ſhall ſpeak ſomewhat of their cauſe, and their diverſities; which is more properly the buſineſs of the Society: yet with conciſeneſs; becauſe my ſentiments concerning them, have been already delivered in print.

Mr. *Barker* writes, that about 40 minutes after 6 o'clock in the morning of that firſt of *Auguſt*; ſtanding againſt a north window, he heard a continual rumbing noiſe, like a long clap of thunder, as if about four miles off.

At firſt he thought it ſuch, but as not a cloud was to be ſeen, the ſky being perfectly clear, he could not conceive, that it ſhould be thunder.

Then he took it for a wheelbarrow, rattling over the ſtones, juſt under his window. Others in the houſe heard it, and fancied, ſomething was fallen down, and rolling about, above ſtairs. Others in the village ſuppoſed it to be the rattling of a coach, or a cannon let off; or the ſhooting down ſtones out of a cart, or the like.

Many deſcrib'd it with a great thump (ſo they term'd it) accompanied with the rumbling. Some ſaid it was louder than any thunder they ever heard: and that cattle in the fields were much affrighted at it. All agree the noiſe laſted ſome few minutes. Some ſay they heard a great thump again.

It is reported, that a ball of fire was ſeen juſt before; and a great flaſh of lightning.

Mr. *Barker* ſays, that immediately going abroad, he ſaw low in the northweſt, a faint white hazyneſs in the ſky; the reſt of the heavens quite clear. Yet an hour after, many ſcatter'd clouds appeared from that quarter, the wind being from thence: ſo that the day was lowering, yet fair and windy, till the evening. Then a ſlight ſhower fell. But the weather had been moiſt and ſhowery before. And after this, it rained every day, more or leſs, for ſome time. The barometer was now 29. 6. beginning to fall.

Some diſcerned no concuſſion in the earth: others declare poſitively, that the ground ſhook under them. One walking between *Ketton* and *Tinwell* in *Rutland*, ſaid; the concuſſion was violent. But the noiſe was heard all over this county of *Rutland*: as alſo at, and beyond *Stamford*, *Grantham*, *Lincoln*, *Melton-Mowbray*, *Waltham*, *Leiceſter*, *Nottingham*, *Kettering* and *Ruſhden* in *Northamptonſhire*. They ſay, at *Lincoln*, it was repeated again, at 12 at night.

But a concuſſion was felt in the morning, and the noiſe very loud, upon the hill country to the north of *Lincoln*; between the rivers *Trent*, and *Ankam*. So that they concluded, many cannon were fired at *Hull*. Some ſuppoſed many horſes at waggons, were all together running away, down the ſteep hills, from the Heath. It actually ſhook many houſes, and the walls of ſome fell down, about *Frodingham*, *Burringham*, *Lodington*, and *Adingfleet* near the *Humber*. Some houſes ſhook ſo, and trembled, that the walls ſeemed as though they would meet.

I received likewiſe a letter from *Thomas Whichcot* Eſq; knight in parliament for the county of *Lincoln*, intimating, that all the parts of that country were ſenſible of it: both by their eyes and ears; from the motion felt, and from the exploſion, or noiſe accompanying. He adds, upon reflection, he has the greateſt reaſon in the world, to judge, its cauſe to be aerial.

Aſſuredly, we may make this obſervation upon what has been ſaid; that the horrible noiſe heard around ſo large a ſpace of country, and which always accompanies an earthquake, muſt not acknowlege any ſubterraneous origin; and can be no other than an electrical ſhock, a ſtroke in the atmoſphere, the ſame as makes thunder. That the concuſſion of the earth being but partial plainly intimates, there was not an univerſal propenſity in the earth's ſurface, to receive the ſhock; it was not in a proper degree of electricity. And this we might well expect, from the moiſt ſtate it muſt needs be in, when the whole year round, the weather has been rainy, to an extraordinary degree.

Whilſt I was writing this, a letter appeared in the Public Advertiſer, for *Monday* the 10th of *November*, from a gentleman in *Yorkſhire*; giving a circumſtantial account of that earthquake, which happened on *March* the 25th laſt, at *Black Hameldon*, *Yorkſhire*, near the place famous for the annual horſe-races, and held there in autumn, with a vaſt concourſe of people.

I judge this anniverſary meeting to be a continuation of the ſolemn *panegyres*, or quarterly aſſemblies of the Druids, for a publick ſacrifice; which were always accompanied with ſports and horſe-races.

At the neighbouring *Oſmotherly* on the ſame hill, is another great meeting held to this day, with horſe-races at the ſummer ſolſtice; called ſtill the Midſummer-games; a like remain of the Druids. And there are ſome eccleſiaſtical privileges now ſubſiſting at the church.

We had a letter concerning that earthquake, read at the Society, on *May-day* laſt, from a gentleman at *Ellenthorp*.

The writer of the 10th of *November* laſt ſays it began with a vaſt thundering, which affrighted the horſes and cattle. That the ſurface of the earth roſe and fell, like ridge and furrow, in plowing; *i. e.* in waves, or vibrations: though he had the common wrong notions of ſubterraneous exploſions, fires from *pyrites*, and the like fancies.

He deſcribes it further, as a great roaring noiſe, like many cannon let off; or loud and rolling thunder. It ſeemed to come from a great ridge of the cliff, on the ſouth-weſt of *Hameldon* hill; particularly from that part called, *Whiſton-cliff*, which I take to mean *White-ſtone*. It is a vaſt and high rock, white in colour, and conſpicuous all the country round, to a conſiderable diſtance. It is of no conſequence to recite the deſcriptions and various appearances, which theſe writers give us, from antiquated apprehenſions, of the cauſe of theſe *phænomena*: but in ſubſtance, it is certain, that a vaſt portion of the ſolid rock was ſtruck down, by the electrical ſhock, from top to bottom of the cliff.

This was done in a perpendicular line, as if cut ſmooth with tools of a maſon. It is deſcribed to be fifteen yards thick, thirty high, above ſixty broad. This was thrown down into the valley, ſplit into many pieces; ſome of which were caſt to the diſtance of five or ſix hundred yards.

Our writer then reaſons upon the ſubject. Was it effected, ſays he, by "a merely natural "cauſe, if ſo, that cauſe muſt have been either "fire, or water, or air. It could not be fire, "for then ſome marks of it muſt have appeared, either at the time, or after. But no ſuch "mark does appear, nor ever did: not ſo "much as the leaſt ſmoke, firſt, or laſt. It "could not be water, continues he, no water

" iſſued out, when the rock was torn off. Nor
" had there been any rain before: In that part
" of the country, a remarkable dry ſeaſon.
" Nor was there any cavity in that part of the
" rock, wherein a ſufficient quantity of water
" might lodge. He concludes, there remains
" no other cauſe, but impriſon'd air, which he
" acknowledges equally inſufficient for producing the effect."

At length he makes it merely ſupernatural. But though we allow it to be the effect of a divine hand, yet that hand can work ſufficiently by means of the power of the electric ſtroke of the elemental fire, ſpread through all nature. And that hand can direct the ſtroke, both as to place and time, as beſt ſuits the purpoſe of a celeſtial monition: where there is ſo great a concourſe of the nobility and gentry every year, according to our writer's hint. " This is wrought, ſays he,
" in ſuch a manner, that the *many* may ſee it
" and fear: And travelling along one of the
" moſt frequented roads in *England*; who muſt
" ſee it, whether they will or no, for many
" miles together.

" Further, it muſt, for many years, maugre
" all the art of man, be a viſible monument of
" God's power."

Theſe and the like are this Gentleman's juſt and pious ſentiments as to the moral purpoſe of theſe wonderful appearances. And it is very obvious to inforce the ſame ſentiments, from the many like, and much more dreadful earthquakes ſince, which this year, fruitful in thoſe natural prodigies, has afforded us all over *Europe.*

For we have found them chiefly directed to great cities and towns. So that if we believe Providence is concerned in the government of the world, we cannot help looking on them in the view of celeſtial monitions.

Indeed, ſince I ſet pen to paper, in this memoir, I have been continually interrupted, with more and more of theſe ſhocking accounts, every poſt: which have unavoidably carried it far beyond its intended bounds.

I am much miſtaken, if our philoſophical ſolution of the cauſe, as well as the aſſigned purpoſe of earthquakes, will not be ſtrongly corroborated by a bare recital, which we muſt needs make of them.

On *Saturday* the 24th of *May* laſt, an earthquake was felt at *Tame,* and *Lillingſton* in *Oxfordſhire.* The ſurface of the earth, and houſes were much ſhaken, but no damage done. That ſame day, I rode from *Oxford* to *Windſor:* Having delivered Mr. *St. Amand*'s fine library, which he bequeathed to the *Bodleian.*

Saturday the firſt of *November*, we had an account in the News Papers, of a ſtrange agitation on the water, in the port and docks of *Portſmouth*: ſo that ſome ſhips rolled fore and aft; others from ſide to ſide. But no motion was perceived on the earth. We have lately received a more particular relation of it at the Society. As likewiſe of the ſame *Phænomenon* at the ſame time, between 9. and 10. *Mat.* at *Plymouth*, from Dr. *Huxam*, who judiciouſly ſuggeſts its true cauſe, an electrical ſtroke: but this was felt likewiſe ſomewhat upon land: as at *Pool*, both on land and water.

Since then, we have had ample accounts both of the agitation on the water and real earthquakes from *Swanſey* in *Wales*, from the coaſts of *Suſſex*, *Surry*, *Kent*, and up the inland parts, *Godalmin*, *Guilford*, *Cranburn*, *Sherburn* caſtle, *Oxfordſhire*, *Luton* in *Bedfordſhire*, *Enfield* near us; moreover it was obſerved at *Peerleſs-Pool*, a large body of water by St. *Luke*'s in *Old Street*. It was found too at *Whitehaven*, *Cumberland*; and in *Loch-Lomund* in *Scotland*, *Lochneſs*, &c.

The ſame was felt half an hour after nine in the morning at *Cork*, *Ireland*; with a conſiderable ſhock of an earthquake. The motions on the ſurface of the earth, are deſcribed to be ſhort, and tremulous. It was quite confined within the bounds of the town.

The electric ſtroke was felt on the water only, at *Kinſale*; not the leaſt breath of wind blowing. The water did not riſe gradually, but with a hollow and horrid noiſe, ruſhed in like a deluge; roſe ſix or ſeven feet in a minute, and as ſuddenly ſubſided. It was as thick as puddle, very black; and ſtunk inſupportably; being ſtirred up from the bottom of the harbor. Very great damages done to the ſhipping, which were whirled about like ſo many corks, and daſhed againſt each other; many were thrown high above land, and there left. It came by fits, at a quarter of an hour's interval; to the infinite amazement of the inhabitants, who feared domeſday was at hand.

Thus fared it with the *Britannic* iſles. And reaſon ſufficient have we, to acknowledge the kind indulgence of providence! but ſince we have been beyond meaſure alarmed, with this terrible judgment taking its hideous ſteps, over the continent; and *Africa*, and *Eaſt* and *Weſt Indies*: whereof we muſt note ſome particulars.

Firſt, we heard of it from *Amſterdam*; the weather calm, as always is obſerved. The chandeliers in ſome churches were found to vibrate; which ſhows a ſlight motion at leaſt, on the land, as well as on the fluid element. But the agitation there, was felt in many parts of the province; particularly at the *Hague*, *Leyden*, *Gouda*, *Rotterdam*, *Leerdam*, *Henkelem*, &c. It was obſerved to run up the rivers *Weſer* and *Elbe*. That it is a property of electricity, I have formerly taken notice of. After this, we find it, the ſame hour, at *Hamburgh*, and *Lubec* in *Holſtein*. The water in the *Trave* roſe four or five feet perpendicular, and ſubſided alternately, and inſtantaneouſly, for a long time. The ſhips ſnap'd their cables. Great damage done to the veſſels in general. The like notices from *Gluckſtad*, and other places thereabouts, accompanied with a real earthquake. It affected the river *Eidar*. The people at *Renſborough* at prayers in the new church, obſerved three large branches ſuſpended from the roof, vibrated very much, from eaſt to weſt. They weighed twenty hundred each. *That* over the baptiſmal font, not ſo heavy, not ſo much affected. The water of the *Stahr* greatly agitated at *Itzeboc*: and a large float of timber was thrown on the bank.

The water ſurrounding fort *Steinburgh* threatened to overthrow the fort: thoſe of the *Ave* the like, at *Veterſen*. The branches in the church too vibrated at *Emſhorn*, *Bramſtat*, *Wilſter*, *Kellinghuſen*, and *Melidorf*. The Waters of the *Schwinge* and the *Ooſt*, greatly agitated, and at *Cuchaven* and other places beyond the *Elbe*.

From *Berlin* they write, the weather being perfectly calm; the agitation in the waters was found in the lakes at *Templin*, *Netzo*, *Mahlgaſt*, *Rodelin*, and *Libbeſc*. The water ebb'd and flow'd ſix Times in half an hour. The fiſhermen at *Netzo* ſaid, that it had an inſupportable ſtench; which ſhews, that the force affects the water, to the bottom of the ſea. It was accompanied with a moſt frightful noiſe.

It was obſerved too in *Norway*, at *Dalecarlia*, and ſome other provinces in *Sweden*. At the ſame time, the rivers, and lakes were extremely agitated.

The ſame day and hour we hear of it at *Madrid*, in form of a real earthquake. It ſhook the *Eſcurial*, ſo that the royal family were obliged to abandon it. Several perſons were killed by the falling of houſes. The people all fled. St. *Andrew*'s church was rent in ſeveral places.

The ſhock was felt at *Bilboa*.

At *Oporto*, ſeveral houſes were quite deſtroy'd: Some churches and ſteeples much damaged. By the ſudden ſwelling of the ſea, the water run higher up, than any tides had ever reached.

The town of *Setuval*, or St. *Ubes*, a flouriſhing place, quite deſtroyed, and many ſhips ſunk. The chain of rocks on the weſt ſide of the town, which contained the quarries of the fine jaſper marble of various colours, ſo valuable, ſplit and rent.

Malaga likewiſe felt a violent ſhock of an earthquake. The bells rung in the ſteeples. The water in a well overflow'd, and as ſuddenly retir'd again. There it was repeated: and the people were ſeized with the ſame fooliſh panic as with us, five years ago; and totally deſerted the city for a whole night.

Great damages done at *Granada*, at *Cordova*, *Anteguera*.

It was violent at St. *Lucar*, and *Sevil*, where the moſt magnificent cathedral has received much damage. Many perſons killed. They look'd on it as the Approach of the day of judgment. The ſea ſwell'd to an amazing height, and enter'd the city, almoſt deſtroyed it. Not a ſingle church or convent has eſcap'd without damage, and few houſes. The borough of *Triana*, the villages St. *Juan*, *Dalfarache*, *Gilbes*, *Brines*, *Camas*, and many others in the neighbourhood demoliſhed. The city of *Areos* likewiſe.

It paſſed above 30 leagues along the ſea-coaſt; breaking off large rocks toward the ſhores, which fell into the ſea.

At *Cadiz* the *French* conſul loſt his life. The ſea carry'd away a vaſt length of the wall, and of the mole: deſtroy'd the long cauſway of two miles, with many people, cattle and carriages upon it, flying from ſo terrible a calamity.

It was felt in the iſland of *Chichlana*, at *Medina*, *Port Real*, and *Cheres*.

It was violent in *Faro* in the kingdom of *Algarva*, quite deſtroyed it; and *Lagos*. Felt at *Silvas*, *Villa-nova*, and all the ſea-coaſt, from cape St. *Vincent*, to the river *Ayamonte*.

The Agitation of the water was ſtrong at *Porta Maria*, at *Salamanca*, *Segovia*; very terrible at *Valentia*, *Coimbra*. The cathedral church, the jeſuits magnificent college, the church of holy croſs, the dominican monaſtery of the inquiſition, and other great edifices entirely deſtroyed there. At *Braga* the ſame.

At *Gibraltar*, the morning was clear, it began with a terrible rumbling noiſe as uſual: then a trembling and violent ſhock. After a ſecond trembling, another ſhock. The guns on the batteries plainly roſe, and fell, like waves: the earth having an undulatory motion. Several things thrown off the ſhelves; and the gable end of two houſes rent. Moſt people ſeiz'd with giddineſs, and ſickneſs, ſtupified; ſome fell down. They that were walking, or on horſeback, felt no motion, but were ſick. In general, all were affected, as if electrify'd, ſo they themſelves expreſs it. The ſea much agitated. The ſhips trembled, and felt a thump at the bottom. The *Dutch* ſhips off cape St. *Mary*'s, fir'd guns of diſtreſs, thinking they ſtruck on ground. A large piece of the rock was ſplit off, into the *Catalan* bay.

At St. *Roque* perſons toſs'd out of their ſeats. An arch of the church rent.

At *Algazeiſt* ſeveral walls fell down, and great part of the town overflow'd.

At *Eſtapona* the church much damag'd.

Now it paſs'd into *Barbary*. At *Arzilla* the water roſe nine Feet. At *Tangier* they ſay 50, perpendicular.

Mequinez has ſuffered much. Two thirds of the inhabitants deſtroy'd. A great mountain ſplit, whence a torrent of water ran for ſome days. All the whole coaſt of *Africa*, with a dozen cities deſtroy'd. *Algiers*, *Tunis*, *Fez*, *Morocco*, *Salle*, &c.

Return we to *Europe*. The iſland of *Minorca* was paſs'd over. Moſt of the provinces in *Spain*, felt its fury. But the whole kingdom of *Portugal* was involv'd in a general deſolation.

The great, the populous, the rich, the ſplendid *metropolis*, and royal palace of *Liſbon*, totally deſtroy'd.

It was felt likewiſe in *France*. At *Bourdeaux*, both the ſhock and the agitation of the water. The river *Soane* by *Lyons* overflow'd ſo ſuddenly and violently, as to do a great deal of miſchief. The like, in other parts of that kingdom.

The whole iſlands of *Sardinia* and *Corſica*, were ſhaken; and the waters agitated very much; and by overflowing, done a great deal of miſchief.

At *Turin* a ſevere ſhock. At *Bazil* in *Swiſſerland*, and the neighbourhood. The lake of *Zurich* much agitated. Felt at *Straſburgh* and *Stutgard* in *Germany*.

This ſame earthquake was felt the ſame time, in the *Weſt-Indies*, in the iſland of *Barbadoes*.

Further the electric ſtroke exerted its fury, on the mountains in *Portugal* and *Algarva*, as well as cities; on the largeſt mountains and ridges of mountains, ſuch as *Eſtrella*, *Arrabida*, *Marvan*, *Sintra*, *Monte Julio*; they were ſhaken from the foundations, and moſt of them open'd at the ſummits, ſplit and rent, in a wonderful manner, huge maſſes of them thrown down into the ſubjacent valleys.

There is no city or place of note in the kingdoms of *Portugal* and *Algarva*, but wha have ſuffered more or leſs: *Villanova*, *De Portimano*, *Taveira*, *Caſtro Marino*, *Beja*, *Elvas*, *Portalegre*, St. *Ubes*, *Caſcaes*, *Sintra*, *Santanem*, *Coimbra*, *Caſtello Branco*, *Lamigo*, *Oporto*, *Viana*, *Braga*, *Guimaraens*, *Villareal*, *Braganza*, *Pinhel*, and others.

It was felt all over *Spain*, except in *Catalonia*, the kingdoms of *Aragon* and *Valentia*.

The rivers particularly ſubject to its influence, prodigiouſly ſwelled, the *Guadiana*, *Minho*, *Douro*. It paſſed up the *Tagus* for 300 miles, as high as *Toledo*, and did damage all the way, on both ſides.

We have many accounts of ſhips at Sea, in the middle of the great ocean, participating in this amazing *phænomenon*. A very loud thundring Noiſe begins it, it ſeems, as if caſks were rolling about upon deck. The maſts, the whole ſhip tremble like a reed ſhaken with the wind. A great thump felt at the bottom of the ſhip, as if it ſtruck upon a rock. The Compaſs often overturn'd in the benacle. The earthen ware, bottles, and the like broke. If in the night, flaſhes of lightning appear, fireballs. The compaſs often loſes its directive power.

But the tremendous Tragedy of *Liſbon* preſents us with a picture of all human woes accumulated. We ſhould ſhudder at the deſcription,

tion, which therefore I forbear, But the principle of electricity ſufficiently diſplay'd itſelf, nor needs any accurate dilucidation : It began with a terrible, rumbling noiſe, as uſual. The ſhocks heaved up the moſt ponderous edifices, and ſhaked them as branches of trees, by the wind. The houſes bent, or nodded to and fro, like the maſts of ſhips juſt mention'd, till they tumbled down ; the upper parts of them firſt. So the ſteeples, and towers of churches. The ground and the ſtreets danc'd under their feet, as they fled, like the wire of an equilibriſt. They expreſs it by the term of undulation, and trembling. Sometime it was ſo violent, that they were oblig'd to lie down, or kneel, not able to keep on their feet.

The city of *Liſbon* is founded on a rock of marble ; ſo much the more ſuſceptible of the electric power, which gave it the vibration. Hence the ruins of churches, palaces, houſes, lie upon their foundations, reſpectively ; as the houſes of cards made by children, thrown down by a ſlight ſhock of a table. And ſo we are to underſtand of all the reſt, in other places.

Here they tell us expreſsly, that there were not any eruptions in the city, fiery, or otherwiſe. But the fires which cauſed the conſequent conflagrations, proceeded from the lamps in churches, and the culinary fires, in the houſes. Some places were ſet on fire, by villains, for ſake of plunder.

They tell us expreſsly, there were no chaſms in the earth, in or about the city, nor all along the coaſt.

The ſhips were likewiſe much agitated. The air in a perfect calm. The water in the river roſe 20 or 30 feet ſeveral times.

Beſide all theſe recited, this fruitful year of earthquakes has produc'd many more, in every part of the globe; both before and ſince the fatal *Nov.* 1. as at our colonies in *America*, at *New-England*, where it did a great deal of damage to the houſes at *Boſton*, particularly the upper part of them, and more to the brick buildings, than the timber ones.

At *Philadelphia* on *Nov.* 20, a ſmart ſhock.

At *New-York*, the morning calm, not a breath of wind ſtirring.

A moſt furious earthquake happened this year at *Cachan* in *Perſia*.

Freſh earthquakes have happen'd in *Holland*, and agitations on the waters: Particularly both at *Leyden* and *Amſterdam*, the water in large veſſels for brewing, were ſenſibly affected.

The like at *Geneva* on *Dec.* 9, in *Franconia*, the dutchy of *Wirtemburg*, *Suabia*, the *Briſgau*, *Alſace*, moſt parts of *Swiſſerland*.

At *Milan*, *Dec.* 9, violent. The water extremely agitated. Great buildings rent. Furniture of private houſes thrown down.

From *Maeſtricht* on the 26th, a ſhock. At the ſame time at *Nimeguen*, *Arnheim*, *Venlo*, *Cleves*; in the *Weterau*. Alſo at *Niewied*, *Bonn*, *Cologne*, *Coblentz*, *Neuſs*, *Duſſeldorp*, *Juliers*, *Duren*, *Stolberg*, *Stablo*, *Malmedi*, *Spa*, *Verviers*, *Barico*, *Neaux*, *Aix-la-Chapelle*, *Liege*, *Lidt*, *Namur*, *Mons*, *Ath*, *Louvain*, *Molmies*, *Breda*.

On *November* 17, an earthquake felt about *Whitehaven*, *Cumberland*. A moſt violent tempeſt of rain and lightning, at the ſame time, with us at *London*. Mr. *Barker* writes from *Lyndon*, *Rutland*, that it was a very tempeſtuous night. Men ringing the bells at *Ridlington* church, beſide the wind and rain, heard a moſt affrighting noiſe, as if the ſteeple was tumbling down, which made them all run out of the church. The ſame noiſe was heard by others, in their houſes, in the ſame town.

December 18. an earthquake ſaid to to be upon the river *Wye* in *Herefordſhire*, attended with a great rumbling noiſe, to the aſtoniſhment of the neighbourhood, who thought the world at an end. A cliff with the trees growing on it, were ſtruck down into the river.

Thus we have recounted a ſhort, and general view, of this moſt wonderful, and to many perſons and places, fatal effects of this great power of nature, which we call an earthquake: chiefly on that *Nov.* 1. The name of earthquake given by our anceſtors was, with much greater propriety, than uſually attended to; and which carries evident tokens of its true, and genuine cauſe.

We have ſince loſt ſight of it, by our deſcriptions deriv'd from a prepoſſeſſion, in favour of a wrong cauſe; fiery eruptions, vapors, gaping ground, and the like. Whereas 'tis really a quaking, or *tremor* only of the earth, of the ſurface of the earth: not like the rending, and exploſion of a mine of gunpowder, at the Siege of a town, which toſſes up all before it, or above it, men, ſtones, and earth, into the open air.

We have only recited the places, and chief circumſtances, which ſhow its cauſe: which we are to underſtand, as a merely ſuperficial vibration: no chaſms, ſinking of towns, cities, mountains, rivers, or the like fanciful appearances. But hiſtoriography is not the only purpoſe of the Society. We muſt endeavour to find out the cauſes of things.

It is indubitably owing to the power of electricity, exerted in the atmoſphere; the ſame as makes thunder and lightning. This power ſubſiſts in a vibration. The ſtronger and more ſolid the matter excited by it, the ſtronger are the vibrations. Whence cathedrals, churches, palaces, goals, caſtles, towers, rocks, ſtone-houſes, and firmer kind of buildings ſuffer moſt, and firſt: juſt as the philoſopher ſome time ſince, applying a cannon, inſtead of a ſlighter conducter, in his electrical experiments, met with his fate, from the violence of the ſhock.

That theſe portents of nature always happen, in a calm, in dry weather: that the cattle in the fields are affrighted at it; that the prelude is a moſt horrible noiſe: that it affects ducks, and geeſe above water, fiſhes in the water, fowls in the yard, birds in the air; all ſhows an aerial cauſe.

The ſame is pronounced of the ſickneſs, *vertigo* and the like, ſeizing men and women, eſpecially of weak conſtitutions, in childbed, or lately handled with a diſeaſe: of which I know ſeveral inſtances, beſides thoſe commonly recited: that balls of fire, coruſcations accompany: that a quarter of the globe was here affected at the ſame time, both land, and ocean; *Britain*, *Ireland*, from *Norway* to *Morocco*, and *Barbadoes* Iſland: that bells rang in ſteeples, in houſes, chandeliers vibrated in churches:

that this effective power runs along rivers, ſea-ſhores, touches maritime places chiefly; indeed all its appearances whatſoever conſider'd free from old prejudice, effectually diſcharge ſubterraneous fires, *pyrites* and cinnaber, from blame; and aſſert the electrical ſhock, its genuine cauſe.

They that can fancy ſuch fires running acroſs the ſolid globe from *Cornwall* under the ocean, to *Barbadoes*, to *Portugal*, *Africa*, *Norway*, like ſquibs in the air acroſs a ſtreet, are not to be argued with.

On the 11th *November* this year, a ſmart ſhock of an earthquake at *Philadelphia* in the *Weſt-Indies*. The like at the ſame time at *New York*. The ſame in *New England*, at *Boſton*.

The ſame was felt at the ſame time, at *Norden Syſſel* in *Iceland*. A violent ſhock at *Huſewig*, and upon the water. We can acknowledge no other than an aerial cauſe to touch countries ſo diſtant.

From the journal book of the ſhip, the Queen of *Hungary*, Capt. *Veale*, I received this extract. It lay under the King's palace at *Liſbon*, *Nov.* 1. laſt. The weather more ſerene and calm than uſual. About 40 minutes after 9 in the morning the ſhock began, with a ſtrange and frightful rumbling noiſe, ſeeming to deſcend from the atmoſphere. Toward the evening a violent ſhock completed the ruin of the city. It was preceded, and attended by moſt terrible lightnings.

And a great ball of red fire, in appearance as big as the ſun, was ſeen.

Theſe were now viſible, as being in the night: when in the day time, inviſible.

In ſo ſurprizing an effect as an earthquake, and ſo unaccountable a cauſe as electricity, a cauſe but recently conſidered, or known, is it to be wondered at, if ſome difficulties occur? can we yet pretend to unriddle all the ſecrets of electricity; though we know ſome: and in my apprehenſion are ſufficiently clear, as to the efficient before us?

Some objections there are, not inſuperable. For inſtance; in electrical experiments the ſhock is ſingle, and momentary; but earthquakes are felt for ſome few minutes.

To anſwer which, we need not urge; how fear and frights multiply, and magnify objects, and appearances. But ſuppoſe the vibrations of an earthquake laſt two minutes, there can be no compariſon, between our little *apparatus* in experiments, and the ſtroke upon ſeven hills, whereon *Liſbon* is built. The vibrations of muſical ſtrings are in proportion to their length, and thickneſs: the ſame of bells, and the like. There is no compariſon between the ſnap in our little experiments, and a ſhock upon the globe of the earth; whence the horrible noiſe rolling from one eminence to another: as in the air, the thunder is re-echoed from one cloud to another.

Again, ſome find difficulties from apertures in the earth, and ſinkings into the ſea, as is the caſe of the key at *Liſbon*; and the like. So as to mountains opening, and rivers of water guſhing out. I profeſs theſe inſtances move me not in the leaſt, to derive them from the bowels of the earth. The electrical ſtroke from the atmoſphere muſt divide a key, and puſh it into the ſea, or a ſtreet that ſtands on a cliff; as it divides rocks, cliffs, mountains; and tumbles them down, like as the above recited caſe of *Whiteſtone* cliff, *Yorkſhire*.

In mountains we expect reſervoirs of water, whence ſprings and fountains flow, by an inexplicable operation of nature. And why may not electricity puſh rocks, and ſmall iſlands into the ſea. Though probably ſeveral of theſe caſes are reported only from relations, under a falſe notion of the cauſe.

Some may object, that if the earth was electrified on an earthquake, every perſon ought to feel it; as when touch'd in the electrical experiments. But we know, the perſons in a room where ſuch experiments are try'd, are not neceſſarily electrified. Yet we find in earthquakes in fact many affected, as if electrify'd, by ſickneſs: And all kind of animals are fully ſenſible of it, and extremely diſturbed.

Sometime, the caſe of *Herculaneum*, and ſuch fancied accidents are quoted, as places ſunk, by force of an earthquake. But this is an erroneous poſition. The city remains intire. It was not ſhaken in its laſt *cataſtrophe*, but buried in the *lava* poured upon it from mount *Veſuvius.* Theſe and ſuch like, are little objections, which it is not worth while, to be elaborate in anſwering; as having no foundation on principles of philoſophy.

1 *May* 1751, I received a letter from *Peterborough*, by order of the literary Society there, with an account of a woman at *Sutton* by *Wansford*, who had been quite deaf for two years laſt paſt, but was perfectly reſtored to her hearing, on *Sunday* 30 *September* preceding, being the day of the earthquake there. She found herſelf reſtored half an hour before the ſhock.

April 1751, we had an account from *Edenburgh*, of a perſon reſtored to the uſe of ſpeech, from a reſolution of the nerves, by electrifying. His name *Robert Mowbray.* Theſe and many like caſes confirm our reaſoning.

Though the power that produces theſe amazing ſtruggles in the elements, be manifeſtly one, and the ſame, yet it admits of ſome difference in its action; not only as it may be more, or leſs forcible, of more or leſs extent, or as to the different object of its action, but likewiſe in its manner. And this points out ſome names of diſtinction, which are at leaſt uſeful, in all parts of learning and philoſophy.

1. We may therefore denominate one of theſe appearances, the *air-quake*. This ſhows itſelf only in the air, in a moſt horrible rumbling noiſe, like many cannon let off, echoing from one hill to another. It may be called terreſtrial thunder. The earth feels not its force, or but ſlightly, or partially, here and there; muſt not be thought to be in a proper electric ſtate, and therefore not fully ſuſceptible of the ſhock. This is owing to a preceding rainy, moiſt ſeaſon: which is always adverſe to electricity.

A loud clap of thunder in the atmoſphere, may be heard over a circle of 500 miles diameter. The ſame clap diſcharged at the ſurface of the earth the 1ſt of *Auguſt* laſt, was heard all over the counties of *Lincoln* and *Rutland*; and part of all the circumjacent counties. It aroſe to an earthquake, wherever the ground was in a proper

per diſpoſition for it, more or leſs. They that can ſuppoſe this *phænomenon* to ariſe from underground, are not to be argued with.

2. A ſecond kind we may call a *waterquake*; which exerts itſelf in the air, and water, as this on *Nov.* 1. with us; cauſing a moſt vehement agitation of that element, lifting it up, and throwing it down by pulſes, toſſing it over the banks of canals, whirling about ſhips, and boats, ſhaking, and daſhing them one againſt another, ſtirring up the water from the very bottom: raiſing it from the bottom of Wells, and the like.

This appearance occurs in the middle of the ocean: on the land, here and there accompanied with real ſhocks of an earthquake, whereever the earth is in an electric ſtate. This *phænomenon* muſt acknowledge the ſame aerial origin.

The water is a ready object of its force, both from its mobility, and from its ſolidity. It chuſes to run up rivers, to any length: to run along the ſhores, as ready conductors. They that can fancy ſubterraneous boilings like a culinary fire, under all the canals, lakes, rivers, ſea-ſhores, and the ocean, affected at the ſame time, over a quarter of the globe, eſpecially in the veſſels of water prepar'd for brewing, are not to be argued with.

We are to conceive, that the electric power falls furiouſly on the water, by reaſon of the extreme ſolidity of the component particles of that moſt wonderful fluid element: whoſe ſole property it is, of all matter, to be abſolutely incompreſſible. Hence it more readily attracts, and aſſiſts the vehemence of the elemental, electric fire. Hence it ſo readily falls on rocks, mountains, ſteel, ſolid buildings, metals, the bones, and joints of animals, and whatever is of moſt ſpecific gravity.

This therefore cauſes a thump at the bottom of a ſhip in the ſea, as if ſtriking on ground; this ſhakes, and quivers the maſts, like an aſpen leaf.

3. The third diverſity, we call properly the *earthquake*: a *tremor* of the ſurface of the earth, accompanied with the two preceding, eſpecially the firſt, the rumbling noiſe. Theſe undulations are boundleſs, as to ſpace, time, or violence; as far as the earth is prepar'd to receive them. For if a muſical ſtring be not rightly ſtretcht, it has no tone. So a wire in electrical experiments never ſo far extended, receives the touch, through its whole length.

It cannot be hard to obſerve, that all conſiderations ſhow the impoſſibility of a fire underground perpetrating theſe dire calamities of earthquakes. The like as to the agitation in the waters, which was perceiv'd even in great veſſels of water for brewing: and more, even in lead when in fuſion, at that ſame inſtant of time, as I was credibly inform'd.

We muſt likewiſe affirm, that the fire, and ſmoak of vulcano's, is the effect of the electrical ſtroke, not the cauſe. The great noiſe is preluſive of the fire, that kindles their component ſulphurs, at the very ſummit; like a match of brimſtone ſtruck by a flint and ſteel. Nor can there be any fire, low in the earth, where there is no conveyance of air, no more than in an exhauſted receiver. And though fires are found in the bottom of coal-mines, and the like, where the air can deſcend; yet we never hear of earthquakes caus'd by them.

4. A fourth kind, I hold to be what we vulgarly call a *waterſpout*, which is ſeen both on the water, and on the land. 'Tis a partial exerciſe of the aerial power, that lifts up the water in the ocean, rivers, wells, canals. A ſingle *vortex* or column, ſometimes viſible of a great height.

In the accounts from *Cadiz* and other places, the water is ſeen coming from the great ocean, like a mountain, and when at the ſhore covering the land: and many of theſe like columns or ridges 50 or 60 foot high, more or leſs, ſucceeding one another. The like appearance *cæteris paribus* in lakes, canals. All theſe are twing to the ſame aerial power that makes the water-ſpouts.

All theſe four kinds proceed from the ſame cauſe, under ſome differing circumſtances, ſingle, or complex, greater or leſſer. The *rationale* of them we leave to further diſquiſition, content to point out ſome of them, and enumerate their *ſpecies*.

I ſhall mention a pertinent obſervation of our friend the learned Dr. *Pocock*, archdeacon of *Dublin*; in his excellent deſcription of *Egypt*, pag. 195.

" It has hardly been known, ſays he, that
" they had any earthquakes which did miſchief,
" in *Egypt*; and thoſe that rarely happen'd
" were ſcarce perceivable. But in *January*
" 1740, they had three great ſhocks, imme-
" diately, one after another; which threw
" down ſome moſques, and ſeveral houſes. It
" being a year of ſcarcity (therefore dry, from
" failure of the *Nile*) all the people prayed
" for plenty of corn. As they have a ſtrange
" notion, that at ſuch times, the Heavens are
" opened, and their prayers heard."

Aſſuredly, this notion of the *Egyptians* may be accounted orthodox, as well as philoſophical. They look upwards for the cauſe, as well as the uſe, to be made of theſe extraordinary movements, under our feet. Happy are we,

if

if we think in the ſame manner. It may pu us in mind of one circumſtance, ſeen generally throughout all that we have hitherto ſpoke of. The chief inſtances of earthquakes are notoriouſly directed to cities, great and rich owns, places of traffick and concourſe, that the numerous inhabitants may be induc'd ſeriouſly to take warning at ſuch judgments, and apply to the Divine Being, *whoſe majeſty is as his mercy*.

Is it not a manifeſt intimation of a ſupernatural hand, that directs theſe natural cauſes, theſe elemental convulſions; and of infinite goodneſs; when in the almoſt univerſal deſtruction of the city of *Sevil*, for inſtance, only four perſons loſt their lives.

To come home, how ought we to adore the good providence of God, who ſpar'd us of this iſland, in ſo wonderful a manner! turning what we reckon'd a calamity, into the greateſt bleſſing; I mean the rainy ſeaſon laſt winter, and ſpring, and ſummer, and autumn, and the preſent winter, which we may juſtly conclude, ſav'd us from the hideous ruin of the more ſouthern climates.

Even in the extreme *cataſtrophe* of *Liſbon*, where more than 40,000 perſons are moſt miſerably periſh'd, about a ſcore only of our countrymen are involv'd in the number. And the only buildings left ſtanding, are the *Engliſh* and *Dutch* proteſtant chapels.

I ſhall conclude this eſſay, with a piece of criticiſm reminded by a learned friend Mr. *Woolfe.* We have ſeen univerſally, that all theſe earthquakes and agitations happen in a ſerene ſky. We have aſſerted their cauſe to be electrical ſtrokes from the atmoſphere, the ſame as thunder and lightning. Now, that thunder and lightning which produces earthquakes, is found in a clear ſky, free from clouds, was known to that great *genius Horace*, as appears very fairly, from ode XXXIV. of firſt book; but not commonly underſtood, from want of a true pointing. Thus,

Parcus deorum cultor & infrequens,
Inſanientis dum ſapientiæ
Conſultus erro; nunc retrorſum
Vela dare, atque iterare curſus
Cogor relictos. Namque Dieſpiter
Igni coruſco nubila dividens
Plerumque; per purum tonantes
Egit equos, volucremque currum.
Quo bruta tellus, & vaga flumina
Quo Styx & inviſi horrida Tænari
Sedes, Atlanteuſque finis
Concutitur.

A *comma* is uſually put after the word *dividens* but erroneouſly. Mr. *Baxter* diſcerned, it ought to be after the word *plerumq*; otherwiſe 'tis not agreeable to that good ſenſe we ought to find in our poet: and it now ſhows he was a philoſopher too.

It may thus be tranſlated, and too well accommodated to the preſent times.

Seldom do I obſerve the ſacred day,
And when at Temple, ſmall devotion pay
To the great Deity; but rather ſtand
A hero in the unbelieving band;
From terrors of a future judgment freed,
To *Epicurus*, I refer my creed:
But all in vain. For hitherto great *Jove*,
Who o'er the clouds his thund'ring chariot
drove;
Of late his fierceſt lightning has been ſeen
To dart impetuous, thro' the ſky ſerene.
The ſolid earth an awful tremor feels,
The rivers dance before his chariot wheels.
To *Africk*'s ſhores the rapid ſhock extends
E'en to the dreadful *Stygian* cave deſcends.
The yawning realm of *Tænarus* appears
Awakens conſcience with unuſual fears.

Read at the *Royal Society*, *January* 15, 1756.

W. Stukeley.

FINIS.

Sir ISAAC NEWTON's
ÆTHER
REALIZED:
Or, The SECOND PART of the
SUBTIL MEDIUM PROVED,
AND
ELECTRICITY rendered Uſeful.

BEING

A Vindication of that ESSAY, in Anſwer to the ANIMADVERSIONS made thereon by the MONTHLY REVIEW;

WHEREBY

The ELECTERAL FLUID, and the SUBTIL ÆTHERIAL FLUID of Philoſophers are, from the NEWTONIAN Principles, clearly demonſtrated to be one and the ſame Thing:

WITH A

Variety of REMARKABLE OBSERVATIONS relative thereto.

By R. LOVETT,
Of the Cathedral Church of WORCESTER.

LONDON:
Printed for the AUTHOR, and may be had of him;
And alſo ſold by
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(Price One Shilling.)

Sir ISAAC NEWTON's

ÆTHER

REALIZED, &c.

IT may perhaps be thought ſomething particular, that, as a Reply to the *Monthly Review* was intended, why it did not appear till two Years after: To which I anſwer; I had for a conſiderable Time after the Publication of that Review, given over all Thoughts of making any Reply to it; but being in Company with a Gentleman of my Acquaintance, he thought proper to tell me, my Book on Electricity was (to uſe his own Expreſſion) knock'd o'the Head by the *Monthly Review*. This harſh Reflection cauſed me to tell him, I was very ſure the Authors of that Review knew but very little of Electricity, for otherwiſe they would never have condemned me; and that Part of my Pamphlet relating to the Production of Electricity, for not being explained according to the Principles of the *Newtonian* Philoſophy, which, as I might well ſay, was becauſe I had not performed an Impoſſibility, and that I was able to prove as much from Sir *Iſaac Newton*'s own Words, and that the Laws by which ſuch a ſubtile Spirit acted were not then known, for Want of proper Experiments; ſo that after Reaſoning with the Gentleman ſome little Time, he told me, if what I ſaid could be proved, I was to blame if I did not return an Anſwer to that Review, or to the ſame Effect.—This was what determined me to make a Reply to their Charge; but what protracted the Time to ſo great a Length, was almoſt continual Interruptions.

However, on the whole I had reaſon to believe, that the length of Time before I made my Reply, anſwered one uſeful Purpoſe; which was, that ſome Things worthy of Obſervation lately occurred to my Thoughts, which I had not conſidered before; and having, after the Publication of that Review, no Hopes of a ſecond Edition of the Pamphlet, whereby to communicate to the Publick any Amendments, or farther Improvements, ſince my firſt Impreſſion, or rather my Ability of writing on the Subject of Electricity was condemned; for though with ſo little Reaſon (as will appear farther on) yet I ſoon found a viſible Alteration in the Sale of the Pamphlet; ſo that I may truly ſay, my ſecond Attempt on Electricity was the ill Succeſs of my firſt, on Account of the Animadverſions made thereon by that Review.

The particular Places of my electrical Eſſay, with the Animadverſions on the ſame, are as follow.

Monthly Review for *Dec.* 1756, p. 561.

Title Page.

" *The ſubtile Medium proved, or that wonderful Power of Nature, ſo long ago conjectured by the moſt ancient and remarkable Philoſophers, which they called ſometimes Æther, but oftner Elementary Fire, verified. Shewing, that all the diſtinguiſhing and eſſential Qualities aſcribed to Æther, by them and the moſt eminent modern Philoſophers, are to be found in electrical Fire, and that too in the utmoſt Degree of Perfection: Giving an Account, not only of the Progreſs and ſeveral Gradations of Electricity, from thoſe ancient Times to the preſent, but alſo accounting, Firſt, For the natural Difference of electrical and non-electrical Bodies. Secondly, Shewing the Source or main Spring from whence the electric Matter proceeds. Thirdly, Its various Uſes in the animal Oeconomy, particularly when applied to Maladies and Diſorders incident to the human*

“ *Body, illuſtrated by a Variety of known*
“ *Facts. Fourthly, The Method of applying*
“ *it in each particular Caſe. And, Laſtly,*
“ *The ſeveral Objections brought againſt it ac-*
“ *counted for and anſwered.*”

ANIMADVERSIONS of the REVIEW.

“ The Author has ſaved us the Trouble of
“ telling the Reader, what he may expect to
“ meet with in this Pamphlet; the above Ti-
“ tle being a compendious Epitome of the
“ whole Performance.—It will alſo be ſuffi-
“ cient to apprize him, that, whatever Diſ-
“ coveries may be contained in it, are not de-
“ livered in a very elegant Manner. Our
“ Author has, in his Preface, made an Apo-
“ logy for this, and candidly owns he has
“ been unhappily deprived of thoſe acquired
“ Abilities, of polite Education, &c. and
“ adds that, therefore, whatever can be
“ plainly and clearly made appear by one
“ in ſuch a Situation, will be allowed to be
“ the Effect of undiſguiſed Truth only, as
“ depending principally on Facts.”

REMARK.

Then comes their infallible Reaſon to prove that all I have ſaid relating to the Production, &c. of the electrical Fluid ſtands for nothing.

ANIMADVERSIONS.

"*But the Want of literary Accompliſhments,*
"*is not his only Defect; for though he ſeems to*
"*have delivered his Sentiments with Candour*
"*and Sincerity, yet, at the ſame Time it ap-*
"*pears, that he is a Stranger to ſeveral of the*
"*common Principles of the* Newtonian *Philo-*
"*ſophy, and conſequently but indifferently qua-*
"*lified to account for the many ſurpriſing*
"*Phænomena of Electricity.*"

REMARK.

I muſt own I was ſo far from being diſappointed at this, that it was the very Thing I expected from ſome Zealot or other for the *Newtonian* Philoſophy; I mean, if my Pamphlet was thought worthy of Notice.— But is this arguing like candid Philoſophers? Is what appears ſo much like a Sophiſm (pardon the Expreſſion) ſupported by no real Proof, to paſs for ſound Reaſoning?

N. B. This I call a Sophiſm, not becauſe they endeavoured to make the World believe, that the Production of Electricity was not to be accounted for, without the Aſſiſtance of a previous Knowledge of the *Newtonian* Philoſophy, when they were not ſure of it, but chiefly becauſe of ſuch an Inſinuation.—— Namely, That I pretended to account for the *whole electrical Phænomenon*, or, as they term it, *the many ſurpriſing Phænomena of Electricity*, notwithſtanding they at the ſame Time allow my Title Page to be a juſt Epitome of the whole Performance; and if ſo, I may as juſtly appeal to themſelves, whether I have been guilty of ſuch an enormous Preſumption or not; and I do aſſure thoſe Gentlemen, I am ſo far from thinking myſelf capable of accounting for the *many ſurpriſing Phænomena of Electricity*, that I am rather inclined to believe, Electricity has opened the largeſt Field for Enquiry, that was ever known, even ſo great as probably never to be exhauſted.

That I expected ſome ſuch kind of narrow Treatment, appears from what is hinted in the Preface of that Eſſay.

I had no Doubt but there were thoſe ſo bigotted to the *Newtonian* Principles, that would think I had been too free, and had not ſtuck cloſe enough to them; but if Electricians * are to be ſhackled and tied down to any kind of known Principles whatſoever, they'll move on but heavily towards a clearer Diſcovery of the many ſurpriſing Phænomena of Electricity.

And now let me aſk, what has been more prejudicial to true Philoſophy, or what has more retarded its Progreſs than Faction, when joined with Prejudice and Bigotry? Is it not generally allowed, that Bigotry in Philoſophy has been as pernicious in its Effects with regard to Truth as Bigotry in Religion; and notwithſtanding this, yet how readily we fall into the ſame Error, which we ſo juſtly condemn in others.

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* A Term made uſe of in Mr. *Franklin*'s Letters.

What could be more abſurd and ridiculous, than the eſtabliſhing *Ariſtotle*'s Philoſophy in the Schools, in ſuch a Manner that no other muſt be admitted; where it is to no Purpoſe, even at this Day, to urge that Sir *Iſaac Newton*'s Philoſophy ſo greatly excels, as that the other ought to yield to it.

It is in vain, it ſeems, to preſs the ſtrongeſt Reaſons, ſince *Ipſe Dixit*, pronounced with a magiſterial Air, and imperious Voice, decides all Controverſies.

And don't we act the ſame Part over again, juſt as if we thought Philoſophy had received its utmoſt Stretch of Improvement, when we admit of nothing which is not explained according to the *Newtonian* Principles, but condemn it before we have conſidered whether it is capable of being explained by theſe Principles or not, as in the preſent Caſe.

Thus we obſerve, an *Ipſe Dixit* to be the dernier Reſort of the *Newtonians*, as well as the *Peripatetics*; and is the *Ne plus ultra*, as well *without* as *within* the Schools.

Mr. *Cotes*, in his Preface to the *Principia*, after confuting ſome of the Tenets of *Des Cartes*, and others, argues thus:

“ All ſound and true Philoſophy is founded “ on the Appearances of Things, which if “ they draw us never ſo much againſt our “ Will, thoſe Principles are not therefore to “ be laid aſide, becauſe ſome Men may perhaps diſlike them. They may call them, “ if they pleaſe, Miracles or occult Qualities, but Names maliciouſly given, ought “ not to be a Diſadvantage to the Things “ themſelves: Philoſophy muſt not be corrupted in Complaiſance to theſe Men, for “ the Order of Things will not be chang’d.” [And if all true Philoſophy is founded on Obſervations and the Appearance of Things: I hope I may without Offence communicate to the World ſuch Obſervations as I have made on theſe modern Experiments, particularly ſuch as I had never ſeen taken Notice of by others.]

“ Fair and equal Judges will therefore give “ Sentence in Favour of this moſt excellent “ Method of Philoſophy, which is founded “ on Experiments and Obſervations. To “ this Method it is hardly to be ſaid or imagined, what Light, what Splendor, hath “ accrued from this admirable Work of our “ illuſtrious Author,* whoſe happy and ſublime Genius, reſolving the moſt difficult “ Problems, and reaching to Diſcoveries, of “ which the Mind of Man was thought incapable

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* Sir *Iſaac Newton.*

" capable before, is deſervedly admired by
" all thoſe who are ſomewhat more than ſu-
" perficially verſed in theſe Matters.—The
" Gates are now ſet open; and by his Means
" we may freely enter into the Knowledge of
" the hidden Secrets and Wonders of natural
" Things. He has ſo clearly laid open and
" ſet before our Eyes the moſt beautiful
" Frame of the Syſtem of the World, that
" if King *Alphonſus* were now alive, he
" would not complain for want of the Graces
" either of Simplicity or of Harmony in it."

And may we not with as great Reaſon truly affirm, with regard to ſuch a ſubtile, active Fluid as Sir *Iſaac Newton* affirmed to lie concealed in the Pores of all groſs Bodies, that now by Means of the modern Electricity, the Gates are ſet wide open.

In his Days ſuch an Æther appear'd but very imperfectly, ſince it was no otherwiſe diſcernible than by a few caſual Effects; yet ſo manifeſt were thoſe Effects that he ſpent no ſmall Part of his Thoughts on it, endeavouring, if poſſible, to find out ſome Means or other to demonſtrate the Certainty of the Doctrine: This muſt be allowed the Caſe, ſince we find interſperſed in ſo many of his Writings ſomething concerning the Subject.

But the Veil which then ſo obſcured the Subject, is by Means of Electricity removed, or rather quite taken away; and that there is in Fact ſuch a ſubtile and powerful Agent concealed in the Pores of groſs Bodies, appears now in large indelible Characters, and ſo plainly, that he who runs may read them.

What an amaſing Diſcovery this, and yet how neglected! Had we but another Sir *Iſaac Newton*, to cultivate ſo great a Diſcovery, might we not ſay with the Author, *What Light*, *what Splendor*, ſhould we not reaſonably expect to be reflected from hence on the ſtill hidden Secrets of Nature?

Had thoſe Gentlemen Enquirers acted candidly, they would, at the ſame Time, when they had affirmed, that the Knowledge of the *Newtonian* Principles was abſolutely neceſſary before the electrical Phænomenon could poſſibly be explained, have given full Proof of it, or at leaſt, ſo far as to ſhew wherein I had failed for Want of the Aſſiſtance of thoſe Principles; nor could any Thing leſs than ſuch a Method of Proceeding, juſtify ſuch an Inſinuation.

That ſuch Kind of periodical Criticiſms are exceeding neceſſary, on Account of their Uſefulneſs in pointing out ſuch Subjects and Performances as appear moſt worthy of Peruſal, is ſo obvious as not to be denied; yet on the other Hand it will alſo be allowed, that the Authors of ſuch Reviews ought to be endued, not only with the greateſt natural Abilities, but Men of the moſt extenſive Learning, free from all Partiality and Attachment to Party on any Conſideration whatſoever;

ſoever; for otherwiſe they muſt frequently fruſtrate the laudable Work they have undertaken, in impoſing on the Public, by miſleading thoſe who expect their Aſſiſtance.

'Tis true, theſe are ſuch Requiſites as are rarely to be met with in the ſame Perſon, and very few MARTINS are to be found; but although this Inconveniency may be remedied by a Society of Gentlemen, well ſkilled in all the different Parts of Learning, and by that Means nothing might be cenſured but what is firſt carefully examined; yet this does not appear to be the preſent Caſe; and although I ſhould be ſorry to make any Reply that ſhould ſeem to have the leaſt Tincture of ill Nature, yet, in Vindication of my Performance in particular, and in Juſtice to the Cauſe of Electricity in general, I cannot help being ſo plain as to ſay, thoſe Gentlemen appear, in great Meaſure, Strangers to Electricity; for otherwiſe they muſt have been ſenſible, that after having made a ſufficient Number of thoſe Experiments with due Attention, it was very poſſible to acquire ſo much Knowledge of its natural Properties, as to be able to meaſure and compare it with the Æther as deſcribed by Sir *Iſaac Newton*, and by that Means to diſcern whether they are one and the ſame, or two diſtinct ſubtile Fluids; and this, without ſuch a previous Knowledge of the *Newtonian* Philoſophy. Had they been ſkilled in Electricity, ſurely they would have given a ſmall Specimen of it, by deſcending, at leaſt, to ſome few Particulars, rather than ſuch general Terms, and condemning all by the Lump.

Since Sir *Iſaac Newton* ſuppoſes a certain ſubtile, active, and powerful Matter, conſtantly reſiding in the Pores of groſs Bodies, and as the modern Electricity ſo undeniably proves the Truth of it, I thought I might boldly affirm they were one and the ſame ſubtile Fluid, eſpecially as the electrical Fluid is endued with all the remarkable Qualities he aſcribed to his ſubtile Æther: If this was what offended thoſe Gentlemen, I here faithfully promiſe to retract all I have ſaid concerning it, and make the moſt humble Submiſſion, if they, or any one elſe, can prove the Exiſtence of ſuch another ſubtile Fluid in Nature, endued like this, with all the eſſential Properties aſcribed to Æther; but if no other ſuch Fluid is to be found, 'tis preſumed I have a Right to inſiſt, that my Concluſions concerning their Sameneſs are juſt; for thus far I am well aſſured Sir *Iſaac Newton*'s Principles will ſupport me.

But they little thought that when this was proved I might have gone much greater Lengths, and on a firm Foundation, *viz.* I might have inſiſted, that this ſubtile Fluid operates rather as a Spirit than like groſs Matter; and that the Particles of Bodies do not mutually attract each other from any inherent Qualities in the Particles themſelves, as is generally ſuppoſed, or in any other Manner than as they are acted upon by the Force and Action of this ſubtile Spirit: Though, had I proceeded ſo far as to affirm, that this ſubtile, active Spirit, was the Cauſe even of muſcular Motion itſelf, Sir *Iſaac Newton* would have borne me out, who thus concludes his inimitable *Principia.*

" And now we might add ſomething con-
" cerning a certain moſt ſubtile Spirit, which
" pervades and lies hid in all groſs Bodies;
" by the Force and Action of which Spirit,
" the Particles of Bodies mutually attract
" one another at near Diſtances, and co-here
" if contiguous; and electric Bodies operate
" to greater Diſtances, as well repelling as
" attracting the neighbouring Corpuſcles;
" and Light is emitted, reflected, refracted,
" inflected, and heats Bodies; and all Sen-
" ſation is excited, and the Members of ani-
" mal Bodies move at the Command of the
" Will, namely, by the Vibrations of this
" Spirit, mutually propagated along the
" ſolid Filaments of the Nerves, from the
" outward Organs of Senſe to the Brain, and
" from the Brain into the Muſcles. But
" theſe are Things that cannot be explained
" in few Words, nor are we furniſhed with
" that Sufficiency of Experiments, which is
" required to an accurate Determination and
" Demonſtration of the Laws, by which this
" electric and elaſtic Spirit operates." *Princip.* Lib. III. p. 393. *Motte*'s Tranſlation.

Is it not well worthy of Remark, that Sir *Iſaac Newton* has no ſooner concluded his Demonſtrations of the Laws of Bodies, but he tells us of another Kind of fine ſubtile active Matter in Nature, ſo different from the Matter with which thoſe Bodies he had been treating of were compoſed, as if he imagined it belonged to another Claſs of Beings.

This active Agent appears to him, as the Life or Soul of common Matter, *viz,* " *By* " *the Force and Action of this ſubtile Spirit,* " *the Particles of Bodies mutually attract each* " *other.*" And does he not here plainly declare, that the Laws of Motion which he had been taking ſuch indefatigable Pains to explain, and to which all common Matter was ſubject, were by no Means the ſame Laws by which the electric and elaſtic Spirit was governed.

May we not then from hence ſafely infer, that the *Newtonian* Principles are ſo far from being abſolutely neceſſary to aſſiſt when this electric Spirit is to be explained, that they ſeem rather incapable of it; as Sir *Iſaac Newton* himſelf tacitly owns, when he tells us, " *they were not then furniſhed with ſuch a* " *Sufficiency of Experiments as was neceſſary* " *to determine and demonſtrate the Laws by* " *which it operates:*" Nor indeed, were he ſtill living to ſee ſuch an electric and elaſtic ſubtile Fluid, actually produced from the Pores of groſs Bodies, would it be poſſible for him to determine and demonſtrate the Laws by which it operates, were he to be tied down to any known Principles whatever relating to groſſer Matter.

And to ſay the Truth, we now ſeem thoroughly convinced, that to furniſh out ſuch a Sufficiency of Experiments was no other Way to be effected, than by Means of Electricity, which was what Philoſophers were not then aware of, notwithſtanding Electricity was in no ſmall Perfection in Mr. *Hawkeſbee*'s Time, and after him brought to much greater Perfection by others, and at Length inflammable Liquids were kindled by it; yet, as in all this Time no conſiderable Force was obſerved in it, 'twas hardly poſſible to think it ſo powerful an Agent as it afterwards proved; conſequently none imagined it to be the ſubtile and powerful Æther of Philoſophers.

But after the *Leyden* Experiment was diſcovered, i. e. after a Method was *revealed* to *Van Muſſchenbroek* (pardon the Expreſſion) to collect, arreſt, and detain a Quantity of it; and particularly after that Method was improved with large Glaſs Jars, whereby a much greater Quantity was detained than in the *Leyden* Vial, which firſt diſcovered the Force: After the above Improvements, I ſay, the Force appeared to be ſo great as ſcarcely to be equalled by any Thing, and out-done by nothing; ſo that when compared with the Æther, as deſcribed by Sir *Iſaac Newton*, it was obſerved to tally with it to the greateſt Exactneſs, even in its moſt eſſential Properties; ſuch as extreme Rarity, Subtilty and Velocity, remarkable Activity, and ſurpriſing Elaſticity; conſequently, according to Sir *Iſaac Newton*'s own Rule, it muſt neceſſarily be what I had attempted to prove, namely, the very Æther itſelf; for, according to his firſt Rule of Reaſoning in Philoſophy,

"We are to admit no more Cauſes of na-
"tural Things, than ſuch as are true, and
"ſufficient to explain their Appearances.

"To this Purpoſe the Philoſophers ſay,
"that Nature does nothing in Vain, and
"more is in Vain when leſs will ſerve; for
"Nature is pleaſed with Simplicity, and af-
"fects not the Pomp of ſuperfluous Cauſes."
Princip. Book III. Rule I. p. 202.

Nor am I yet ſenſible wherein I tranſgreſs Sir *Iſaac Newton*'s Rules, in proceeding to Inferences and Concluſions, after having made Experiments with due Attention, for this alſo is what I am taught by that greateſt of Philoſophers.

"In experimental Philoſophy we are to
"look upon Propoſitions, collected by general
"Induction from Phænomena, as accurately,
"or very nearly true, notwithſtanding any
"contrary Hypotheſes that may be imagined,
"till ſuch Time as other Phænomena oc-
"cur, by which they may either be made
"more

" more accurate, or elſe liable to Exception." *Princip.* Book III. Rule IV. p. 205.

The ſame Rule Mr. *Martin* thus explains: " Propoſitions and Concluſions de-
" duced from actual Experiments, muſt be
" eſteemed true and accurate, notwithſtand-
" ing any Hypotheſes, or received Suppoſi-
" tions to the contrary; and muſt be inſiſt-
" ed on, till ſome other Phænomena, either
" render them more accurate, or liable to
" Exception." *Philoſ. Gram.* Edit. II. p. 16.

Conſequently according to ſuch Reaſoning, I have not only a Right to inſiſt on my general Concluſions, but it is my Duty: I am told, I muſt inſiſt on them till ſome other Phenomena, either render them more accurate, or elſe liable to Exception; therefore till then, they muſt reſt where I have left them.

This Rule " Sir *Iſaac Newton* tells us
" muſt be obſerved, that the Argument of
" Induction may not be evaded by Hypo-
" theſes;" conſequently if they are not to be evaded by Hypotheſes, much leſs are they to be evaded by what falls ſo much ſhort of an Hypotheſis, *viz.* a looſe indeterminate way of arguing, ſupported with no one ſingle Proof.

Again. " If no Exception occur from
" Phænomena, the Concluſion may be pro-
" nounced general.—But if at any Time
" afterwards any Exceptions ſhall occur from

“ Experiments, it may then begin to be “ pronounced with ſuch Exceptions as oc- “ cur.” *Optics*, Edit. III. p. 380.

Such generous and ſound Reaſoning is highly worthy of its great Author; here is good Quarter allowed to the Experimentaliſt, with Encouragement for him to proceed in his Reſearches, inſtead of uſing all the Means in his Power to intimidate him who is endeavouring to propagate what he has experienced in uſeful Knowledge.

Having thus far proved the Validity of my grand Aſſertion, to wit, that the electrical Fluid, and Sir *Iſaac Newton*'s Æther, are one and the ſame Thing, it is preſumed I may take it for granted; eſpecially ſince there is not the leaſt Shadow of Probability of any other Fluid like this, reſiding in the Pores of groſs Bodies; endued with all the Marks and diſtinguiſhing Characteriſtics of Æther; and which, according to Sir *Iſaac Newton*'s firſt Rule of Reaſoning above-mentioned, muſt be unphiloſophical to ſuppoſe, * as will farther appear: I ſhall therefore henceforward, ſuppoſe them one and the ſame, and ſometimes call the electrical Fluid by the Name of Æther.

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* Sir *Iſaac Newton* expoſes the Opinion of two diſtinct Æthers in Nature, his Words are,

“ How two Æthers can be diffuſed through all Space, “ one of which acts upon the other, and by Conſequence is “ re-acted upon; without retarding, ſhattering, diſperſing “ and confounding one another's Motions, is inconceivable.” *Optics*, *Quæ*. 28.

That thoſe Gentlemen are egregiouſly miſtaken; and that what they aſſume and take for granted with ſuch an Air of Aſſurance, (*viz.* that to explain Electricity the *Newtonian* Principles are abſolutely neceſſary) has no Foundation, will more plainly appear by inſtancing in a few other Particulars.

Sir *Iſaac Newton*'s Axioms, or Laws of Motion, it is preſumed, are allowed as fundamental Principles, and yet how repugnant to the Laws obſerved by the electrical Fluid, do ſome of them appear, when compared therewith; namely,

1ſt. Law of Motion of the Inertiæ of Bodies.

" *Every Body perſeveres in its State of*
" REST, *or of* UNIFORM MOTION *in a*
" *right Line.*" Princip. Book I. p. 19.

But neither Philoſophers or Experience inform us, that the ſubtile fluid Æther is ever at reſt; on the contrary, Philoſophers always ſpeak of it as reſtleſs, and in perpetual Motion, but not in uniform Motion, and in a right Line; and it may be truly ſaid, that inſtead of the Inertiæ, (common to all groſs Matter) nothing appears in the electrical Fluid, but real Activity. Again,

3d. Law of Motion on ACTION and RE-ACTION.

" *To every Action there is always oppoſed an*
" *equal Re-action; or the mutual Actions of*
" *two Bodies, upon each other, are always e-*
" *qual, and directed to contrary Parts.*"
Page 20.

This Axiom, although never obſerved to deviate with reſpect to groſs Bodies; not only as to thoſe Bodies among themſelves, but between groſs Bodies and the Air, or Atmoſphere likewiſe, which both reſiſts, and is alſo reſiſted by groſſer Bodies; but the electrical Fluid is ſo far from being reſiſted by groſs non-electrical Bodies, that it is obſerved to penetrate their Pores with the greateſt Freedom; and what is the moſt wonderful of all, is, that the more denſe and compacted the groſs non-electrical Bodies are, with ſo much the greater Facility the electrical Fluid flies, or rather darts through them, as is manifeſt in the moſt denſe Bodies of all others, even Gold itſelf; through the minute Pores of which it paſſes with the utmoſt Freedom, and we are always ſenſible of the greateſt Effects in the *Leyden* Experiment, when the electrical Fluid is conducted through thoſe denſeſt non-electrical Bodies.

If then the groſs Matter of which thoſe denſe Bodies are compoſed, be no Impediment to the Progreſs of the fine Fluid paſſing through it, conſequently thoſe groſſer Bodies will meet with no Reſiſtance from that; agreeable to the ſame third Law.——Then, may we not ſafely conclude, that one eſſential Property of Æther, is that of not reſiſting the Motion of groſs non-electrical Bodies.

COROLLARY.

Hence one of the greateſt Paradoxes in all Nature, will be exemplified; namely, why the non-electrical Planets may preſerve their whole Motion, although performed in the midſt of a Plenum, of ſuch a ſubtile Medium.

Once more, to illuſtrate and confirm the above Reaſoning: All Bodies compoſed of groſs Matter, conſtantly point out an attracting, or gravitating Tendency towards each other; while on the contrary, nothing can be much more obvious than that repelling Force which ever ſubſiſts between the ſeveral Parts of this ſubtile Fluid.*

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* But although the Particles of the electrical Effluvia ſo manifeſtly appear to repel each other, yet they do not, in a ſtrict Senſe, ſeem to repel ſo much as the ſmalleſt Particle of non-electrical Matter; for although we ſo frequently ſee them

Many other Inſtances of the like Nature might be produced, but this ſmall Specimen, it is preſumed, is abundantly ſufficient to prove it to be governed by quite different Laws from thoſe of common Matter, and conſequently that the *Newtonian* Principles, are not ſo neceſſary to explain and account for Electricity, as theſe Gentlemen imagined.

Upon this Principle, *viz.* that Action and Re-action do not obtain and take Place between the electrical Fluid and non-electrical Bodies. Many other Things equally ſurpriſing will be diſcovered, and ſo far from appearing as Paradoxes, that, on the contrary, they will flow like ſo many natural Conſequences; ſuch as why the Guinea and downy Feather ſtill deſcend with equal Velocity, in a Receiver exhauſted of Air; although at the ſame Time ſo great a Quantity of this ſubtile Medium be conveyed into it as to become viſible, and appear luminous: As alſo why the Mercury in the Gage of the Air-Pump, is not depreſſed by ſo great a Quantity of the moſt elaſtic Principle in all Nature; notwithſtanding, if the leaſt

Quan-

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them repelled in the electrical Experiments, this is not till they have been electriſed, and by that Means furniſhed with an electrical Atmoſphere, which they have no ſooner parted with, but that (if in the Sphere of Attraction) they immediately return back to the excited Apparatus again.

Quantity of Air be introduced into the Receiver, it is ſufficient to depreſs it.

Query. What then muſt counterbalance ſo ſurprizing an elaſtic Force of a Fluid, which in its natural State is obſerved to be 700000 Times greater than the elaſtic Force of the Air? † Can any Thing but the circumambient Atmoſphere be ſufficient, ſince we find by Experience that the Particles of the Quickſilver in the Gage, are not capable of it.

If it be replied, the Atmoſphere has no direct Communication with the Vacuum, at the upper End of the Gage; it may be anſwered.——The homogeneous Particles of the Æther contained in the Pores or Vacuities of the Column of Mercury in the Gage, communicate both with the Æther in the Vacuum at the upper End, as alſo with the Atmoſphere at the lower End, and by that Means ſerve as a Fulciment, or Prop to the one as well as the other; conſequently, as ſurely as the Air is capable of reſiſting and counterbalancing the Particles of Æther at the lower End of the Column of Mercury, ‡ ſo ſurely will the whole be counterbalanced.

Thus

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† This appears to be Fact from a juſt Calculation of Sir *Iſaac Newton*'s, in the 21ſt Quæ. of his Optics.

‡ There is not any Experiment wherein the Atmoſphere does not appear capable of counterbalancing the electrical Fluid.

Thus we find the common Air to be capable of reſiſting and counterbalancing, not only the ponderous Column of Mercury in the Gage, but alſo the greateſt Quantity of this elaſtic Fluid in the Vacuum: The former of which is performed by its Preſſure, or Weight, and the latter by its repelling Quality as an Electric per ſe.

I ſhall not pretend to ſay, that becauſe I have obſerved that Action and Re-action do not obtain and take Place between Æther and groſs Matter, that it is therefore a Diſcovery; becauſe if the Æther be a Spirit, as Sir *Iſaac Newton* affirms, the reſt muſt follow as a natural Conſequence; this being agreeable to our Idea or Conception of a Spirit, *viz.* that a groſs Body is not capable of reſiſting it.——But although I am not ſo arrogant as to claim the Diſcovery, yet I can truly aſſure the Reader, I never obſerved it to be taken Notice of by any one before.

The Theory of moſt other Diſcoveries and their Improvements, that have been made in either Nature or Art, are ſo eaſily attained by Reading, that an elegant Novice has oftentimes appeared ſuperior in Skill to an experienced Artiſt with whom he had been diſputing; but in electrical Enquiries this is not to be done: For Electricity being ſo lately arrived at its preſent Perfection, few Helps are to be expected from Books only; particularly as no Authors who treated of it before the *Leyden* Experiment could poſſibly ſay any Thing of it ſo very extraordinary, as ſince.

To ſay the Truth; the feeble State in which Electricity appeared before that Experiment was diſcovered, conveyed no Ideas of any conſiderable Force, nor was it ſo much as ſuſpected by Sir *Iſaac Newton* himſelf, as plainly appears from his own Account of it: Who, when ſpeaking of Light, Fire, and Electricity, was ſo far from thinking this electric and elaſtic Fluid to be the ſame with his powerful electric and elaſtic Fluid, that he tells us,

“ If a glaſs Globe be put into a Frame,
“ and turned ſwiftly round its Axis, it will,
“ in turning, ſhine where it rubs againſt the
“ Palm of ones Hand applied to it: And
“ if at the ſame Time, a Piece of white
“ Paper, or a white Cloth, or the End of
“ ones Finger be held at the Diſtance of about
“ a quarter of an Inch, or half an Inch
“ from that part of the Glaſs where it is
“ moſt in Motion; the electric Vapour which
“ is excited by the Friction of the Glaſs
“ againſt the Hand, will, by daſhing againſt
“ the white Paper, Cloth or Finger, be put
“ into ſuch an Agitation, as to emit Light,
“ and make the white Paper, Cloth or Fin-
“ ger appear lucid like a Glow-worm; and

“ in ruſhing out at the Glaſs * will ſometimes puſh againſt the Finger ſo as to be felt. — And the ſame Things have been found by rubbing a long and large Cylinder of Glaſs or Amber, with a Paper held in ones Hand, and continuing the Friction till the Glaſs grew warm.” *Opt. Quæ.* 8.

Was not this a very feeble State: Was it not morally impoſſible he ſhould imagine that that which exhibited but little more Light than a Glow-worm, was capable of being rendered more like that of the Meridian Sun †; or that which appeared with a Force but juſt ſufficient to be felt againſt the Finger, was yet capable of being ſo increaſed, as to be equal to a Force ſufficient to overturn a Mountain ‡; or prove fatal to a whole Army of men in an Inſtant, which might now be compleatly effected, if the *Leyden* Experiment were to be made with a ſufficient Number of Mr. *Franklin*'s large glaſs Jars in the

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* This, which was then thought to ruſh out of the glaſs Globe, has ſince been diſcovered to ruſh out of the Hand, Fingers, *&c.* as is evident not only from Experiment the Firſt of my former Eſſay, but from numberleſs others, particularly by Mr. *Rackſtraw*'s Thirty-fifth Experiment, performed with his ſulphur Globe, p. 51. of his Eſſay.

† See Mr. *Rackſtraw*'s Eſſay, p. 65, 66.

‡ It is the Opinion of Mr. *Franklin*, from what he has experienced with his large glaſs Jars, that the greateſt known Effects of Lightning, may, without much Difficulty, be exceeded by the Fire of Electricity. See his Letters, p. 94.

Place of the Vials, and a whole Army of Men to join Hands and form the Circuit; and what is yet more ſtrange, is, that if the Force be but increaſed to ſuch a Degree as to kill a ſingle Man, which all Electricians very well know to be practicable; ſo ſurely would it, (for any Thing that ever appeared to the contrary,) kill every one in the Circuit, were there ever ſo many.

As theſe, and many other Things in Electricity equally ſurpriſing, are ſo manifeſt as not to be denied, and yet to be met with in very few Authors; it muſt follow, that none but the Electrician himſelf, can be a competent Judge of the Ability of others in the electrical Way.

N. B. Having been repreſented ſo mean a Philoſophaſter as to be quite ignorant of the common Principles of Philoſophy, and as thoſe Gentlemen ſeemed to think, of all Kind of Science: I hope for this Reaſon to be excuſed by the candid Reader, if I ſhould inform the Monthly Reviewers, that although I own myſelf to be no Adept in Literature, ſtrictly ſo called; yet am I not an entire Stranger to Philoſophy, nor to mathematical Learning; even to the analitical Art, and may therefore be capable of reading (at leaſt) not only the *Principia* in general, but the analitical Demonſtrations likewiſe; ſo that if I am ſuch an entire Stranger to the *Newtonian*

Principles as I am repreſented, it muſt be altogether my own Fault.

But although Sir *Iſaac Newton* ſeemed ſo thoroughly convinced, that ſuch a certain moſt ſubtile Spirit, conſtantly reſides and lies hid in the Pores of all groſs Bodies; yet as this could never be clearly proved to the Senſes, before the Diſcovery of the *Leyden* Experiment; as he had no Method to give ocular Demonſtration, even of the Exiſtence of any ſuch active and powerful Agent; it was no Wonder if ſuch a Doctrine was diſbelieved, and treated rather like a Dream than real Fact, at leaſt ſo with the Bulk of Mankind: And to ſay the Truth, the only principal Difficulty, all eminent Philoſophers laboured under when treating of this Subject, was want of proper Experiments to demonſtrate to the Senſes, that ſuch a ſubtile and elaſtic Agent really and actually exiſted; for if this could have been but once effected, few ſeemed to doubt of the powerful Effects aſcribed to it.

This Difficulty then, which always appeared ſo inſuperable, is at length, by Means of Electricity, moſt happily ſurmounted; and ſuch an aſtoniſhing, powerful, ſubtile, and elaſtic Fluid, is actually diſcovered to exiſt, and this not by Halves, but if poſſible, much to exceed all that was ever conceived of it: And never was any Phænomenon exhibited to Mankind in a more favourable Manner for

Examination than this. Few Experiments can be wiſhed for, which may not be moſt eaſily made. No Experiment, of whatever Kind, can be made in any Branch of natural Philoſophy, that in general appears more convincing, and conſequently more concluſive; and although it muſt have appeared ſo difficult a Taſk to prove what Sir *Iſaac Newton* affirmed of it, namely, that it pervaded and lay hid in all groſs Bodies; yet this is by Means of thoſe modern Experiments ſo clearly and evidently proved, as to be put beyond all Diſpute.

In a Word, we are bleſſed with every neceſſary Requiſite, and permitted to torture it with Experiments in whatever Manner we pleaſe, in order to bring it to a ſpeedy Confeſſion of its Nature, Properties, and Uſe to Mankind.

Quæry. As the electrical Fluid is allowed by all, to be the moſt wonderful Phænomenon that ever came under ocular Inſpection, and as, in general, the greateſt and moſt remarkable Diſcoveries have conſtantly pointed out ſome uſeful Purpoſe, or valuable End, can it be reaſonably ſuppoſed, that the great Revealer of SECRETS ſhould conduct Mankind to the moſt ſurpriſing and wonderful Diſcovery that was ever known, to ſerve no other Purpoſe than merely to amuſe them?

May we not ſafely infer, that as ſurely as Nature never acts in vain, ſo ſure are we that ſo ſuperlatively great a Diſcovery or Revelation (if I may be allowed to call it ſo) was never made to ſerve ſo vain an End only, but rather Ends proportionably great? Conſequently, if Means and Ends are proportionate, and if all the Operations of Nature are in juſt Proportion of Number, Weight, and Meaſure, the greateſt ENDS of all others are here deſigned.

It is preſumed this grand Diſcovery will not (particularly by the judicious Philoſopher) be eſteemed the Effect of blind Chance only; that the remarkable Blow which was firſt felt by the famous Profeſſor *Muſchenbroek*, was merely accidental; or that the Earth and its numerous Inhabitants can be thought ſo inconſiderable a Part of the Creation, as that the Hand of divine Providence ſhould have no Share in ſo remarkable a Tranſaction (a Privilege, which perhaps the Inhabitants of no other Part of the whole ſolar Syſtem may be yet favoured with) for this might juſtly be cenſured as no ſmall Mark of Infidelity.

But the Manner alone, by which the Knowledge of the great Power and Force of Æther, was at firſt communicated to Profeſſor *Muſchenbroek*, was moſt remarkable; for no Experiment ſince that, of the ſame Kind, and made after the ſame Manner, ever appeared ſo formidable; where the Vial was ſmall, and furniſhed moſt probably with cold Water, and unarmed, *viz.* unaſſiſted with a metallic Coat, according to the preſent Method of Improvement made Uſe of to increaſe the Force; yet, under all theſe diſadvantageous Circumſtances (as he informs us) he received ſo violent a Blow, that he thought himſelf nearly expiring, and therefore could by no Means prevail with himſelf to repeat the Experiment.

That Experiment appearing ſo widely different from all that have been ever made of the ſame Kind, and ſhewing ſo much greater Force than any one that has ever been ſince attempted, when no Art was made Uſe of to increaſe the Force, *Quæry*, Whether this ought not to be eſteemed a ſufficient Hint to inform us, that that Phænomenon in particular, came not but by a ſpecial Commiſſion?

And although I muſt own myſelf indebted to thoſe Gentlemen Enquirers, for allowing, not only that my Title Page is a true Epitome of the whole Performance, and conſequently a juſt Title; but particularly, that I have delivered my Sentiments with Candour and Sincerity, which will be allowed to be no deſpicable Character as an Author.

Yet, ſince the next Words are deſigned as the greateſt Detraction, it will be neceſſary to go over the chief Things again, to diſcover either wherein I had failed in the Attempt (ſince they have not done it) or elſe to illuſtrate and confirm the ſame.

The principal Things advanced in my Title Page are,

1ſt. To prove that the Fluid brought under ocular Inſpection, by Means of the electrical Apparatus, is the very Æther of Philoſophers.

2dly. The Cauſe of that remarkable Difference between electrical and non electrical Bodies.

3dly. From whence the electric Matter is derived, or the Source from whence it proceeds.

4thly. It's Benefit to the human Body when applied as a Remedy to Diſeaſes; each of which has been again ſtrictly examined.

Firſt then, That the electrical Fluid is the very Æther, 'tis preſumed is what is now queſtioned by few Philoſophers; although when I wrote that Pamphlet it did not ſeem ſo generally allowed; and to ſay the Truth, I was for that Reaſon under ſome Apprehenſion of being publickly chaſtiſed (if thought worthy of Notice) for affirming it ſo confidently, becauſe I was ſo audacious as to be the firſt who had ventured to ſpeak his Mind on that Head ſo freely, at leaſt, that I ever knew of, although ſeveral had hinted the ſame Thing before, particularly the ingenious Mr. *Wilſon*, in a former Treatiſe on the electrical Fluid, who ſhewed it ſo plainly to be his real Opinion, and his Arguments ſo convincing, that I could not help admiring his Opinion was not more generally received, notwithſtanding the great Modeſty with which he delivered his Sentiments: Others ſtill more cautious, only affirming the Æther to be the *Cauſe* of the electrical Phænomenon: For theſe and ſuch-like Reaſons, I was determined, at all Events, to venture and ſpeak my Mind without any Reſerve, eſpecially as I was ſo ſure I could confirm my Arguments by the moſt convincing Experiments.

But, contrary to my Expectation, no one that ever I heard of, condemned me for it. And to my ſtill greater Satisfaction, about the ſame Time my Pamphlet was publiſhed, came out the Obſervations on a Series of electrical Experiments, by the learned Dr. *Hoadly*, in Conjunction with the abovementioned Mr. *Wilſon*; wherein they expreſſed their Sentiments more fully than I had ever ſeen in any Author before, affirming it unphiloſophical to ſuppoſe, that the Æther of Sir *Iſaac Newton*, and the electrical Fluid, were two diſtinct Fluids: 'Tis true, they ſoftened the Expreſſion, by ſaying it was much more philoſophical to ſuppoſe them one and the ſame Fluid, than to ſuppoſe them two.

The Manner in which they expreſs themſelves, is as follows:

" Thus have we gone through the moſt
" intereſting of the electrical Experiments,
" and from the various Appearances they

" afford, it appears, that the electrical Fluid " is as univerſal and powerful an Agent at, " or near the Surface of the Earth, as that " Fluid which Sir *Iſaac Newton*, in his Op- " tics, calls Æther; that it is as ſubtile and " elaſtic in its Nature as Æther is; and as " Æther does, that it pervades the Pores of " all Bodies whatever that we are con- " verſant with; is diſperſed through what- " ever Vacuum it is in our Power to produce " by Art; and from the natural Phænomena " of Thunder, Lightning, *&c.* ſeems to be " extended to very great Diſtances in the " Air.

" We ſhall make no Scruple therefore " now to affirm, that theſe two Fluids are " one and the ſame Fluid; and it is much " more philoſophical to do ſo, than to ſup- " poſe two ſuch Fluids, each of them equally " capable of producing theſe Effects, and " equally preſent every where, which would " be multiplying Cauſes, where there is no " Manner of Occaſion." Dr. *Hoadly*'s and Mr. *Wilſon*'s Obſervations on electrical Experiments, p. 58.

2dly. As to the Deſcription of electrical and non-electrical Bodies, I have peruſed it again and again, and often compared the Deſcription and Experiments together, and can truly ſay I find nothing aſſerted, but what is ſtrictly agreeable with Experience; conſequently, according to Sir *Iſaac Newton*'s 4th

Rule aforementioned, the Concluſions are to be admitted, till Exceptions, founded on Experiments, or at leaſt, on more rational Arguments, can be brought to ſhew their Inſufficiency.

The 3d Thing to be re-examined is, from whence the electrical Fluid is derived, or the Source from whence it proceeds.

The principal Experiment made Uſe of to ſhew this, and to prove it to be from the Earth, is at Page 19, of my Pamphlet; where, inſtead of a Cuſhion, a Hand was ſuppoſed the Inſtrument of Friction, on the prime electrical Glaſs Globe; and is as follows.

EXPERIMENT I.

Tending to point out the Source, or main Spring, from whence the electric Matter is derived.

IF a Perſon ſtanding on the Floor, lay his Hand on the Glaſs Globe in Motion, the electrical Matter is produced in great Plenty, as we find by its acting ſo vigorouſly on the Gun-barrel, or other Apparatus of Wires; but if he ſteps on a Cake of Reſin, &c. it is very much weakened, and very little Fire or Attraction is to be found on the ſame, notwithſtanding the Friction be continued at the Glaſs Globe: To prove that this is no Deception,

ception, let him put a Foot again to the Floor, and they will, that Inſtant, act vigorouſly as before, and be again as inſtantly deprived of great Part of that Power at lifting it up again; and *vice verſa.*

When I began again to examine this Experiment, I ſoon found it capable of Demonſtration by many other Methods, as,

1ſt. If this Phænomenon be produced from the Earth, as I had ſuppoſed; then it muſt follow, if the Perſon on Reſin, while rubbing the prime electrical Glaſs, put his Toe to the Floor, that the Fire will neceſſarily appear between them, if the Room be darkened. This Experiment, when tried, fully anſwered my Expectation, eſpecially if the Shoe were of; and much plainer yet, if a Finger of one on the Floor were brought to the Foot, for then it was not only viſible, but it might be plainly felt and heard to ſnap or explode at paſſing from the Finger to the Foot; and thus the Certainty of what I had undertaken to prove by the Experiment, was compleatly demonſtrated, by being realized to no leſs than three of the Senſes at once.

2dly. If the Perſon with his Hand on the Globe, ſtood on folded Woollen inſtead of Reſin, it was ſufficient; for then, likewiſe, it might be ſeen and felt, if a Finger were brought to the Sole of the Shoe.

3dly. If a Perſon rubbing the Globe, ſtood on a Chain when folded together, the Fire, at paſſing from the Floor to the Foot, appeared between ſeveral of the Links. And,

4thly. I have obſerved it (when the Weather was favourable) to appear between the Fingers and the Sole of the Shoe, even if he ſtood on the Floor and the Sole of the Shoe perfectly dry.

But if a Finger of a Perſon be brought to his Hand or Face when mounted on Reſin, it appears to act with the greateſt Force of all.

From theſe Hints the Electrician will be ſenſible, how the Experiment may be varied many other different Ways, each of which ſerves to ſtrengthen and confirm the Theory.

Hence then, as it is ſo undeniably produced from the Earth, we ſhall find that the Perſon rubbing the Glaſs, is poſſeſſed of the ſame attracting Quality as the Glaſs which he rubs, whenever he ſteps on the Reſin; for as the Friction on the Glaſs is continued, and conſequently the Attraction, and yet can have no Supply from the Earth by reaſon of the Reſin-Cake which intercepts it; the Attraction is communicated from the Glaſs Globe not only to the Palm of the Hand in contact, but diffuſed from thence all over his Body, and accordingly every Part of him attracts any light Bodies that are near very vigorouſly, and he appears as poſitively electriſed, as if it were really ſo, although this can be no more than in Appearance; for he is ſo far from ſuperper-abounding and being inveloped in an electrical Atmoſphere, that he is (if I may ſo ſay) in a State of real Want *.——This Appearance is no Way leſſened, even although a Perſon on the Floor were to lay his Hand on the prime Conductor, or other Part of the Apparatus, which is a plain Proof the Appearance is only negative; for if he were poſitively electriſed as in the common Way, the Hand of the Perſon on the Apparatus would effectually take it all off.

I am acquainted with an ingenious Electrician, who is of Opinion, that the electrical Fluid is collected out of the Air; and that, what convinced him it was not from the

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* It does not appear from Experiment, that any particular Body can be actually diveſted of any Part of that Quantity of this Fluid, which is by Nature aſſigned to it. It muſt be owned non-electrical Bodies ſuffer a Change of it, but no otherwiſe than for an equal Quantity, as is manifeſt by the ſecond Experiment of the Subtile Medium proved, Page 21. in like Manner as when Air paſſes freely through a Tube, which is always replete with Air, and yet conſtantly paſſing out.

Electrical Bodies have likewiſe always the ſame Quantity which Nature has aſſigned them; but the Quantity in thoſe appear rather fixed, or as Mr. *Franklin* expreſſes it, they retain ſtrongly and obſtinately: Conſequently, if Bodies part with none of that due Quantity reſiding in their Pores, neither can any greater Quantity be added. without doing Violence to Nature, which is always the Caſe in the *Leyden* Experiment; particularly when the greateſt Quantity from Mr. *Franklin*'s Set of large Jars are diſcharged through the ſmalleſt Wire: For it does not appear from Experimeut, when any particular Body is electriſed, that any Quantity is added to it, otherwiſe than by Accumulation, which, by Degrees, diſſipates into the Air.

the Earth, was becauſe he could make all the uſual Experiments with the Glaſs Tube, while ſtanding on the Reſin-Cake as while ſtanding on the Floor, and rubbing it, inſomuch as to Fire the Spirits; but this can prove no more than that he is negatively electriſed in the ſame Manner as the Perſon rubbing the Globe on Reſin, who is as capable of firing the Spirits as in the common Way.

But notwithſtanding this ſubtile Fluid ſo plainly appears to be produced from the Earth, and propagated to the rubbed Zone of the glaſs Sphere, through the Inſtrument of Friction and interjacent Body, whether it be the Body of the Perſon whoſe Hand is the Inſtrument, or whether the interjacent Body be the Frame of the Machine, which muſt always be the Caſe, when a Cuſhion is made Uſe of for the Inſtrument of Friction, as it generally is; yet the Reaſon of that great Propenſity in the ſubtile Agent, to arrive at the rubbed Part of the revolving Glaſs, does not ſo plainly appear; nor will it perhaps be eaſy to inveſtigate the Cauſe, ſo as that it ſhall ſeem natural, without recurring to the Dawnings or firſt Appearance of Electricity in the World; which, as it then afforded only a mere Glimmering of what is ſince diſcovered,

Quæry, Muſt not this be a Glimpſe of the *Primum Mobile*, or moſt prevailing Property, ſince what was then pointed out is preſumed to be the moſt predominant Principle? which, although it was no more in thoſe early Times, than a faint Attraction that appeared to be formed at the Surface of the Amber by rubbing it, yet was it even in this minute State, ſufficient to fix the Attention of the Curious, and was what gave Riſe both to the Birth and Name of Electricity; and accordingly all thoſe Things which were afterwards obſerved to be endued with the like Quality of Attraction by rubbing them, were called electrical Bodies.

In this minute State Electricity continued for many hundred Years, and might perhaps have ever remained ſo, had not Mr. *Hawkſbee* happily diſcovered, that ſuch Attraction in the rubbed electrical Body was capable of great Improvement; inſomuch, that if a glaſs Tube were rubbed with the Hand, and then brought within twelve or fourteen Inches of Bits of Leaf Gold, *&c.* they would be briſkly attracted up to the rubbed Part of the Tube. See Mr. *Hawkſbee*'s Experiments, Edit. 2d. P. 53.

This great Diſcovery was much improved by Mr. *Stephen Gray*, of the *Charter-Houſe*; he it was who gave the firſt Hint, that electrical Attraction was capable of being propagated to any indefinite Diſtance, having himſelf proved it to the Diſtance of 800 Feet, by properly ſuſpending a non-electrical Line of the ſame Length, and applying a glaſs

Tube, when rubbed, to one End of it, and light Bodies were attracted almoſt inſtantly at the other End; nor is it much leſs ſurpriſing to behold, how great an Attraction is oftentimes communicated to the glaſs Tube by only one Stroke of the Hand.

And as all other Effects are ſo greatly increaſed, when Experiments are made with the glaſs Sphere revolving on its Axis, ſo no Doubt can be made, but that the Attraction likewiſe of the latter is proportionably greater than that of the former.

What can be more wonderful and ſurpriſing than that attracting State, thoſe vibrating Particles (contained and fixed in the internal Subſtance of original Electrics) are put into, by any violent Agitation at their Surfaces, eſpecially when we conſider how powerfully, as well as viſibly, the Particles of Æther, are thereby drawn from neighbouring non-electrical Bodies? A remarkable Inſtance of this Kind is to be ſeen in Mr. *Rackſtrow*'s Eſſay on Electricity, P. 51; I mean his Experiment with the ſulphur Globe, which, if the Fingers of a Perſon ſtanding on the Floor, were held over it while in Motion, Streams of the original Æther, in great Abundance, iſſued from the Pores of the Fingers on the Globe, although at three Inches Diſtance, exhibiting ſo great a Light and Hiſſing at ruſhing violently againſt the Globe,

as

as greatly to ſurprize the Perſon who made the Experiment: nor can the Truth of this be ſuſpected, it being one of the Experiments he made in Public. And is it not remarkable, that notwithſtanding this great Attraction at the Glaſs Tube or Globe, ſo far as we can judge from Experiment, no Part of it actually enters their Subſtance, unleſs the Air be firſt exhauſted; then, indeed, it pervades the Glaſs with the greateſt Freedom, and the Accumulation, which before was entirely on the outſide, is, after the Exhauſtion as entirely within their void Cavity, as is manifeſt from Mr. *Hawkſbee*'s Experiment above-mentioned, Page 45, and his Experiments with his Glaſs Tube, Page 61.

According to the Method propoſed at Page 52. I ſhould next proceed to re-examine that Part of my Pamphlet relating to the Cure of Diſeaſes by Electricity; but I find it neceſſary to go over the ſecond capital Experiment again: Not that I have diſcovered any Error therein (for on the contrary, I obſerve it to agree ſtrictly with Experience) but chiefly, leſt what I have there proved, and ſhall therefore take for granted, may look like begging the Queſtion, when I may have Occaſion to mention it; I mean, that the electrical Fluid actually paſſes through the Pores of denſe non-electrical Bodies, and not over their Surfaces; therefore, as the Pamphlet cannot be ſuppoſed always ready at Hand, I beg to repeat the whole Experiment, with the Obſervations thereon.

EXPERIMENT II.

The ſubtile Medium proved; Electricity unveiled; or an Experiment tending to prove what it really is; alſo its great Inclination to return into the Earth from whence it came.

IF Wires are ſupported with ſilken Strings to any given Length whatſoever, and then electriſed, although they will ſhew as great an Energy, and produce as ſmart a Crack or Exploſion, at the greateſt Extremity as near the Machine, particularly if the Air and ſilk Supporters are very dry; yet if they are touched but with a Finger of a Perſon ſtanding on the Floor, at the ſame, or any other Diſtance, the whole Length of the Wire will be, that Moment, deprived of its electrical Virtue; and not the leaſt Sign of Fire or Attraction will be found at any Part of the Apparatus, and will be again as inſtantaneouſly reſtored to its former Activity by taking off the Finger.

What Experiment can poſſibly prove any Thing more effectually, than this does that of extreme Subtilty and inconceivable Velocity?

For although when a Finger is on, even at the farther End, no Fire or Attraction is to be found throughout the whole; yet it muſt, at the ſame Time, be undeniably paſſing through the internal Parts of the Wires, and thro' the Perſon into the Earth, otherwiſe it could not again ſo inſtantaneouſly accumulate, and form an Atmoſphere on them at removing the Finger: Or, if inſtead of removing the Finger, he ſteps upon a Cake of Reſin or Bees-Wax, the Effect will be the ſame; and again, if he but touch the Floor with one of the Toes of his Shoes, while ſtanding on the Reſin, and a Finger on the Wire, the whole will again, that very Inſtant, be deprived of its Activity, and ſo continue as long as he either keeps his Foot on the Floor, or if but touch a Perſon with a Finger of the Hand, at liberty.

Quæries.

Does not the Air in this Experiment act the Part of an electric *per ſe*, and that in a moſt remarkable Manner? Were it not ſo, in all Probability, there never could have been the leaſt Appearance of what is called Electricity; it muſt neceſſarily vaniſh into it again as ſoon as excited, notwithſtanding the contiguous Wires and ſilk Supporters; but inſtead of that, does it not cling and accumulate on the Wire, as we find by its attracting light Bodies; forming an Atmoſphere to a conſiderable Diſtance from the enveloped non-electric Body, rather than depart again into the heterogeneous Maſs, from whence * Part of it ſeems juſt collected? And will it not, as it were, ſuffer itſelf to be taken Captive in the Condenſing-Vial, rather than return into the Air?

And does it not ſeem to have as great a Propenſity to eſcape into the Body of the Earth, as a Reluctance towards returning into the Air? Does it not, at the Touch of a Finger, *&c.* though at the greateſt Diſtance, dart that Moment into the Earth, through the Perſon and all the intermediate Wires; or if by this, or any other Means, theſe Wires are brought in contact with any non-electric which has a Communication with the Earth, the Effect is always the ſame, and not the leaſt Sign of Fire or Attraction is to be found on any Part of the Apparatus?

Does not the original Æther in this Experiment, quit the internal Parts of the Wires, and give Place to the newly collected Æther, or electrical Fire, to enter and occupy the ſame Space, and, conſequently execute the ſame Office, which it muſt neceſſarily do, all the Time the Wire has this ſuppoſed Communication with the Earth, and the Machine in Motion? And does it not, as it were, leap into the Earth through the Perſon and the internal Parts of the Wires, ſo inſtantaneouſly, as not to allow Time ſufficient to accumulate or form any Manner of Atmoſphere on the external Parts? For if the ſmalleſt Degree of Accumulation were on the external Parts, ſome ſmall Degree of Attraction would be alſo found, which yet is not the Caſe.

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* Although the principal Part of the electrical Fluid is ſo undeniably attracted from the Hand, and ſupplied from the Earth, yet ſome ſmall Portion may probably be collected from the Air likewiſe, when paſſing between the Hand and revolving Glaſs.

Does not the electrical Fire as effectually paſs from the Machine through the internal Part of the Wire, and through the Perſon into the Earth, as ſurely as Water is conveyed through a Pipe, all the Time the Machine is in Motion, and the Perſon with his Finger on the Wire? And is not this Communication with the Earth as effectually ſeparated by his ſtepping on the electrical Cake, ſince the whole Line that Moment acts vigorouſly?

What much adds to the marvellous Part is, that the Wires being touched, though at the greateſt Diſtance, ſhould ſo affect it, as to put an entire Stop to the Appearance of either Fire or Attraction, throughout the whole Length of the Line, as effectually as if done ever ſo near the Machine.

Upon the Whole, if this Experiment alone is not allowed to be concluſive, I ſhould be very glad to be informed of the Reaſon why? particularly, if we are to ſuppoſe with Sir *Iſaac Newton*, that the Pores of the Wires were replete with the Particles of Æther, before the Machine was in Motion: If the electrical Fire were not actually the ſame Subſtance with the Æther, why would the original Æther, in the Pores of the Wire, be found ſo naturally to ruſh out firſt into the Earth, and give Place to the electrical Æther to follow it? For it is imagined it will not be replied, there was Room enough in the Wire for both, or for the electrical Fire to paſs by the Side of the original Æther, contained in the internal Parts of the Wire.

I have inſiſted the more on this Experiment, becauſe, though it is moſt eaſily performed, yet no Experiment can well be more clear and concluſive, or prove any Thing more effectually than this does, that they are one and the ſame.

Note, Although thoſe Inferences are put as Quæries, yet was it not becauſe they were incapable of farther Proof, even that abſtruſe one above-mentioned, viz. " *Does not the*
" *electrical Fire as effectually paſs from the*
" *Machine, through the internal Part of the*
" *Wire, and through the Perſon into the Earth,*
" *as ſurely as Water is conveyed through a Pipe*
" *all the Time the Machine is in Motion, and*

" *a Finger of a Perſon on the Floor at the Extremity of the Wire.*"

This Quæry may perhaps be thought incapable of any Kind of Proof; yet is it ſo far from it, as to be capable even of ocular Demonſtration by the following eaſy Method:

Let any Part or Parts of the excited Apparatus of Wires, *&c.* be ſupported in ſuch a Manner that they may be clipped aſunder, or otherwiſe divided, without dropping one from the other at each Diviſion, and the Fire will be plainly perceived to move from the one to the other, at every Part ſo ſeparated.

Note; The accumulated Fluid on the Apparatus, ſhewing ſo remarkable a Tendency to eſcape into the Earth, was a ſufficient Hint that it was firſt produced from thence.

Having proceeded thus far in Vindication of my former Eſſay, as I thought ſuch Vindication my Duty; ſo on the other Hand, as I am conſcious of having been guilty of an Error in explaining the *Leyden* Experiment, I think it no leſs my Duty to confeſs and retract it, particularly as I never obſerved it to have been detected by any other Hand; the Miſtake was this.

I had ſuppoſed the Motion of the electrical Fluid along the Circuit to be performed in juſt a contrary Courſe and Direction to what is ſince diſcovered, and ſhould therefore think myſelf inexcuſable, were I to juſtify, or even to paſs over in Silence that which I have ſince diſcovered to be abſolutely falſe *.

What led me into the Error was, that remarkable Congruity obſerved among the Parts of all, or moſt homogeneous (common) Fluids; I mean that remarkable Propenſity of uniting and incorporating with each other, which appears to be a Law or Rule ſo generally obſerved among thoſe Fluids, as to admit of few, if any, Exceptions.—For want of due Conſideration, I imagined that ſo univerſal a Law muſt conſequently prevail among the homogeneous Particles of the electrical Fluid likewiſe, whereas I ought to have firſt enquired into the Cauſe why the former ſo readily unite and incorporate, which appears to be from an attracting Property of the Parts in contact; for this would have informed me, that the ſame Law was inconſiſtent in the preſent Caſe, because the Particles of this elaſtic Fluid are obſerved to repel each other, in as remarkable a Manner as thoſe of common Fluids attract; and conſequently, that the Motion or Direction of the Fluid is the contrary Way to what I had ſuppoſed it.

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* It muſt undoubtedly be the indiſpenſible Duty of every one, who is deſirous of contributing his Mite to the public Fund, or common Stock of Knowledge; (that is, every faithful Author) whenever he diſcovers that he may have committed any remarkable Miſtake, to take the firſt Opportunity of retracting it: For this Reaſon, as I have publiſhed the Miſtake, ſo I very gladly make Uſe of this Opportunity to confeſs it as publicly.

This Error muſt neceſſarily be the Cauſe of others; and it became abſolutely neceſſary to re-conſider the whole Experiment; which I ſhall endeavour to perform in a clear and intelligible Manner, omitting nothing on this abſtruſe Subject, that may appear conducive to the End propoſed, namely, to ſhew in what Manner this amazing Violence, and circulating Shock is produced and propagated.

Note, My preſent, as well as former Hypotheſis, is founded on the Suppoſition of a Vacuum (conſequently, that ſo far the former is ſuppoſed to be juſt) this 'tis preſumed will appear reaſonable, not only becauſe it is not eaſy to conceive how ſuch Violence can be otherwiſe produced, but as it will be found agreeable to Experiment: Such Vacuum is ſuppoſed to be formed by the ſudden Expanſion, or burſting of the condenſed Æther, arreſted and detained in the Vial *: But whether it may really appear reaſonable to ſuppoſe, that ſuch a Vacuum be actually generated in that Experiment or not, as alſo that a Vacuum be abſolutely neceſſary to produce the ſurpriſing Force we behold in that Experiment, is the firſt Thing to be enquired into.

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* The Reſiſtance ariſing from ſuch a Vacuum, is ſufficient to produce any Effect of this Kind whatſoever. Mr. *Wilſon*'s former Eſſay, Page 90.

According to the *Newtonian* Rules, we are to proceed in our philoſophical Enquiries by Analogy, and compare difficult Things under Conſideration, with thoſe we are more intimately acquainted with, in order to try how far the Analogy will hold good, which is well known to be no unſafe Method in mathematical, as well as in philoſophical, Enquiries.

In the preſent Caſe, it may perhaps be ſufficient to compare Profeſſor *Muſchenbroek*'s Vial, when charged with the electrical Fluid, to a Piece of Fire-arms when charged with Gunpowder; in each of which is a Quantity of latent Fire, fixed, and juſt ready to be ſet free: The latter is encompaſſed and confined on all Sides by the Metal, excepting at the open Part of the Tube; the former is encompaſſed and confined on all Sides with electrical Bodies, *viz.* the common Air, and the Glaſs of the Vial.——At the kindling-up of the Fire in the Gun, we obſerve a remarkable Exploſion, and violent Expanſion of the elaſtic Fire; and ſince no Place is left free for the Expanſion but the open Part of the Tube, the Motion is neceſſarily performed along that.—In like Manner, at the kindling-up of the Fire in the Vial, we alſo obſerve a remarkable Exploſion, and violent Expanſion, of the elaſtic Fire; and as all Parts are guarded by the Glaſs and the circumambient Atmoſphere (both electrical Bodies) and nothing contiguous ſo ſuſceptible or ready to yield to the Impreſſion, as the Æther contained in the contiguous non-electrical Circuit, formed for that Purpoſe; the Expanſion (as we obſerve by the Effects) is performed throughout the ſame Circuit, although ever ſo greatly extended. And if a Vacuum be formed at the ſudden Expanſion of the Fire in the Gun,

Quæry, Whether it be not rational to expect ſimilar Effects from two ſuch ſimilar Experiments? and conſequently that a Vacuum is generated in the one Caſe as well as in the other.

Note, Since the following may very poſſibly convey an Idea to ſome Kind of Readers, of the Manner in which a Vacuum is formed at the Diſcharge of a Piece of Fire-arms, I hope to be excuſed the Digreſſion, it being what I was once an Eye and Ear-witneſs of.

In an upper Room of a lofty Building *, I ſaw near the Outſide of the Window a leaden Ciſtern fixed, which ſerved as a Reſervoir to ſupply the Houſe, on Occaſion, with Rain Water; and for that Reaſon a leaden Pipe was fixed to the Cock of the Ciſtern, the other End of which came near the

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* Mr. *Brodribb*'s Houſe in *Worceſter.*

Ground at the oppoſite Side of the Court, to be ready for Uſe.

The Perſon * who ſhewed me the Experiment turned the Cock at the Ciſtern, and when the Water was heard to diſcharge itſelf at the lower End, he re-turned it to cut off a farther Supply of Water from the Ciſtern: The Conſequence of which was, that in a ſmall Time after, a very ſmart Stroke was heard at the Cock of the Ciſtern, and as loud as if it had been ſtruck with a Club, or an Iron Bar.

By this familiar Experiment they will readily conceive, not only in what Manner the Report or Stroke at the Cock was performed, but alſo, that the Effect of it may paſs for a full Demonſtration, that the Method taken by Philoſophers, to account for a Piece of Fire-arms, is juſt; for, as in that, the Fire drives out the Air, and leaves an Emptineſs or Vacuum in the Tube, and the external Air ruſhing in with Violence to reſtore the Equilibrium, is the Cauſe of the Report: So in the preſent Experiment, the Water running out of the Pipe, left an Emptineſs or Vacuum behind it, or at leaſt ſo, in ſome Degree; but when the Top of the Current was come near the Bottom of the Pipe, the external Air ruſhing in with Violence to reſtore the Vacuum, was obſerved to ſtrike with

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* Mr. *Berwick.*

with ſuch Force againſt the upper End where it was reſiſted, much after the ſame Manner (though with leſs Violence) as when the Gun is fired; and doubtleſs, had it been poſſible for the Diſcharge of the Water out of the Pipe, to have been performed as ſuddenly and as violently as the Fire from the Piece, the Effects had been proportionable.

Quæry, Whether the Water which paſſed through the Cock from the Ciſtern was ſufficient to fill the Pipe (through which it paſſed) quite full or not; becauſe, had there been no Way for ſome ſmall Portion of Air to inſinuate, and get above the upper End of the Current of the Water in the Tube, ſufficient to expand itſelf, ſo as to puſh, or drive the Water downward, it could be no more capable of emptying itſelf than the Mercury in the Barometer.——But to return from the Digreſſion.

As it appears ſo reaſonable to ſuppoſe that a Vacuum is inſtantly formed, at the violent Eruption and ſudden Expanſion of the condenſed Fluid in the electrical Vial, it muſt ſeem rational to expect, that ſuch Vacuum is ſome Way or other as inſtantly reſtored, particularly as we perceive ſuch ſudden and violent Effects: But before I endeavour to ſhew how ſuch violent Effects are produced, it may not be unneceſſary firſt to ſhew the remarkable Propenſity of this ſubtile

Agent to arrive at a Vacuum, and the great Facility with which it pervades the Glaſs at ſuch Times, more than at any other; for which Reaſon I ſhall mention an Experiment made by the ingenious Mr. *Hawkſbee*, with his Attrition-Engine, which differed but little from the preſent electrical Machine.

" I took (ſays he) a glaſs Globe of about " nine Inches Diameter, and exhauſted the " Air out of it; then, having turned a " Cock which prevented the Return of the " Air, I took it from the Pump. The " Globe being thus ſecured, I fixed it to a " Machine, which gave it a ſwift Motion, " with its Axis perpendicular to the Horizon; " and then applying my naked Hand (ex- " panded) to the Surface of it, the Reſult " was, that in a very little Time a conſider- " able Light was produced.

" And as I moved my Hand from one " Place to another (that the moiſt Effluvia, " which very readily condenſe on the Glaſs, " might, as near as I could, be thrown off " from every Part of it) by this Means the " Light improved *; and ſo continued to in- " creaſe, till Words, in capital Letters, be- " came legible by it, as has been obſerved

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* That ſame Light was all within-ſide of the Glaſs, as we find at Page 48, when he repeated the Experiment; as alſo at Page 61, when he made Experiments with an exhauſted Tube.

" by Spectators.———Nay, I have found the
" Light produced to be ſo great, that a large
" Print might, without much Difficulty, be
" read by it."—And a little farther on he tells us, " The Light was of a curious pur-
" ple Colour." Mr. *Hawkſbee*'s Experiments, Edit. 2d. Page 45.

OBJECTION I.

How can we believe this electrical Fluid to be that very fine ætherial Medium deſcribed by Sir *Iſaac Newton*? Does it not appear in Mr. *Hawkſbee*'s revolving exhauſted Globe, to be rather of a much more cloudy and groſs Subſtance?

ANSWER.

Sir *Iſaac Newton* himſelf is not of Opinion, that his ſubtile fluid Medium, is always and every where equally fine and rare, as ſome may imagine, but of different Denſity according to its different Situation, as plainly appears from his Letter to Mr. *Boyle*, concerning his Thoughts on Æther and Gravity, where he thus expreſſes himſelf.

" There is one Conjecture more about the
" Cauſe of Gravity. I ſuppoſe the Æther
" to conſiſt of Parts differing from one ano-
" ther in Subtilty by indefinite Degrees:
" That in the Pores of Bodies there is leſs of
" the groſſer Æther, in Proportion to the
" finer, than in open Spaces; and conſe-
" quently, that in the great Body of the
" Earth,

" Earth, there is much leſs of the groſſer
" Æther, in Proportion to the finer, than in
" the Regions of the Air: And that yet the
" groſſer Æther in the Air affects the upper
" Regions of the Earth, and the finer Æther
" in the Earth, the lower Regions of the
" Air, in ſuch a Manner, that from the
" Top of the Air to the Surface of the
" Earth; and again, from the Surface of the
" Earth to the Centre thereof, the Æther is
" inſenſibly finer and finer."

But notwithſtanding this groſs Appearance of Æther, or electrical Fluid, in Places void of Air, yet is its great Subtilty, and powerful Influence, remarkably conſpicuous, even where the Air is not excluded: This is plain from that familiar Experiment of covering Bits of Leaf-Gold, or other light Bodies, with a Glaſs, which will be briſkly attracted and repelled by a rubbed Tube held over them, at more than a Foot Diſtance, although ſeveral Books are piled one upon another over the Glaſs.

Quæry, May not this paſs for a Demonſtration, that Sir *Iſaac Newton*'s Conjectures concerning the different Degrees of its Denſity, were juſt.——From the Effects of the above Experiment, and numberleſs others, it plainly appears that the fineſt Æther is not only the moſt ſubtile, but alſo the moſt active and powerful in every Reſpect.

And notwithſtanding the purple Apparition in Mr. *Hawkſbee*'s Glaſs, yet even in that State, how much more rare than Air (or any Thing elſe, excepting Light) muſt it be, to pervade the Glaſs with ſuch Freedom, although Glaſs ſuffers not the electrical Fluid to paſs through it without Reſiſtance, in the ſame free Manner as through non-electrical Bodies; yet to arrive at, and occupy the void Space, it pervades its Pores with the greateſt Freedom, which, as the Quantity increaſes in the Vacuum, ſo the purple Flame becomes more and more luminous.

And as Æther is allowed by Sir *Iſaac Newton*, and other eminent Philoſophers, to be univerſal, *Quæry*, Whether that purple Colour be not its natural Hue, in all Places void of Air; in the immenſe Void beyond the Earth's Atmoſphere, as well as in artificial Vacuums within the Atmoſphere; for this is agreeable to Sir *Iſaac Newton*'s Rules of Philoſophiſing, *Princip.* Book III. Page 388, where, when ſpeaking of Mr. *Boyle*'s Vacuum, he argues thus:

" Bodies projected in our Air ſuffer no Re-
" ſiſtance but from the Air. Withdraw the
" Air, and the Reſiſtance ceaſes. For in
" this Void a Bit of fine Down, and a Piece of
" ſolid Gold, deſcend with equal Velocity,
" and the Parity of Reaſon muſt take Place
" in the cæleſtial Spaces above the Earth's
" At-

" Atmoſphere; in which Spaces, where " there is no Air to reſiſt their Motions, all " Bodies will move with the greateſt Free-" dom."

Conſequently the ſame Parity of Reaſon will take Place, with reſpect to the purple Colour of the Æther, as well in the cæleſtial Spaces as in the artificial Void. If then the luminous purple Hue is inherent in the univerſal Æther beyond the Atmoſphere, *Quæry*,

Whether the interjacent Atmoſphere be not thereby rendered of that Azure or Sky-Colour?

Laſtly, Can there be any more Reaſon for believing this ſubtile Fluid to be groſs, on account of its Colour only, than there is for believing the Rays of the Sun to be groſs, on account of Purple and other darker Colours contained in them, which are ſo eaſily ſeparated from them with a triangular glaſs Priſm?

Experience, which is the beſt Teſt of all others, informs us, that thoſe Colours are ſo far from proving the Rays to be groſs, that they ſeem rather abſolutely neceſſary to conſtitute that fine clear Brightneſs we behold in them; for although the lighteſt of thoſe priſmatic Colours are much darker than what we conceive of the Sun's Rays, yet are they all no ſooner compleatly blended together by Means of a convex glaſs Lens, but they re-aſſume their primitive Luſtre, and appear of a clear ſunſhine White.

OBJECTION II.

But allowing the *Leyden* Experiment may be ſo analized, as that it may appear reaſonable to ſuppoſe a Vacuum, and the Reſtoration of the Equilibrium were abſolutely neceſſary to the Production of ſo great a Force, yet, why ſhould ſuch Vacuum and Force be generated in the Vial, notwithſtanding the Fire and Exploſion appear at that Part only, where the Circuit is compleated, by bringing the Finger, *&c.* to the excited Apparatus of Wires, although at the greateſt Diſtance from the prime Conductor on which the Vial is ſuſpended?

ANSWER.

Not only becauſe an exceeding vivid Flaſh of Light appears at the ſame Inſtant in the Vial (provided it be lined with Gold or Silver Leaf*, inſtead of being furniſhed with Filings of Metal, *&c.*) but alſo becauſe the ſame Fire, Exploſion, and Light, all appear, even though the Experiment be contracted into ſo narrow a Compaſs, as the Holding the Vial in one Hand, and bringing a Finger of the other to the Cork-Wire, which evidently proves the Force, *&c.* to be generated at the Vial.

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* I never could obſerve that Flaſh of Light in any other Vials: If they are lined with Silver-Leaf, the Light produced is of a beautiful Green.

What confirmed me the more in my Opinion, that the grand Eruption was at the Lining of the Vial, were the three following Experiments.—Firſt, Mr. *Franklin*, of *Philadelphia*, informs us, that if the Coating of the Vial be electriſed, the Shock will be given from that.—The Experiment is thus made:

Take hold of the Cork-Wire, and electriſe the Coating, by bringing it to the excited Apparatus, by which Means the electrical Fluid will be collected and fixed at the Coating; for bring the Coating from the excited Apparatus to a Finger of the other Hand, and the Fire, Exploſion, and Shock, ſucceed in the ſame Manner as in the common Way, which ſhews that the Force was propagated from the metalline Subſtance in contact with the Vial.

Secondly, By another Experiment of Mr. *Franklin*'s it appears, that the electrical Fluid at the Vial, which gives the Shock, is firſt detained and fixed in a particular Manner between the electric and non-electric, *viz.* between the Glaſs and the Gilding.—He informs us in his Letters on Electricity, Edit. 2d. Page 32, that,

" A thin glaſs Bubble, about an Inch Dia-
" meter, weighing only ſix Grains, being half
" filled with Water, partly gilt on the Out-
" ſide, and furniſhed with a Wire-Hook,
" gives

“ gives, when electriſed, as great a Shock as “ a Man can well bear. As the Glaſs is “ thickeſt near the Orifice, I ſuppoſe the “ lower half, which being gilt, was elec- “ triſed, and gave the Shock, did not exceed “ two Grains; for it appeared, when broke, “ much thinner than the upper half.—If one “ of theſe Bottles be electriſed by the Coat- “ ing, and the Spark taken out through the “ Gilding, it will break the Glaſs inwards “ at the ſame Time that it breaks the Gild- “ ing outwards.”

Which could not be, had it been either without-ſide of the Gilding, or within-ſide of the Bubble.

Thirdly, The ingenious Dr. *Bevis*'s Method, where the Experiment is contracted into a yet narrower Compaſs, by gilding a large thin Saſh-pane of Glaſs on both Sides, leaving a Margin all round ungilt: Such a Pane of Glaſs, if laid on one Hand, and the upper Side electriſed, by communicating with a Wire or Chain ſuſpended to the excited Apparatus, will, at bringing a Finger of the other Hand to the Gilding on the upper Side, give a Shock equal to that from a gilded Vial; and this, whether the Circuit be compleated by thus joining it at the Gilding of the Pane, or whether it be compleated at any diſtant Part of the excited Apparatus, provided it be done before the gilded

Pane be removed from the Wire which electrifies it.

The gilded Pane of Glaſs I make Uſe of is in a circular Form, encompaſſed with an iron Frame; to this Frame is fixed a ſmall Handle, by which Means it may be as commodiouſly made Uſe of as the Vial.

N. B. Firſt, If the Glaſs of the Vial or Saſh-Pane exceed a certain Thickneſs, the Experiment will not then ſucceed; becauſe, as the Vacuum for this Reaſon cannot be reſtored, and the electrical Fluid is by that Means hindered from moving compleatly round, the Conſequence is, that no Motion is produced in any Part of the Circuit, and no greater Spark is obſerved, than if the Vial or Saſh-Pane were not concerned in the Experiment.

But, ſuppoſing the Glaſs of the Vial or Saſh-Pane were of a proper Thickneſs, and the Experiment ſucceeds ever ſo well; yet if another Bit of Glaſs of the ſame Thickneſs intercept at any other Part of the Circuit, no one in the Circuit (although ever ſo far from this additional Bit of Glaſs, and ever ſo near the electriſed Vial or Pane) is ſenſible of the leaſt Emotion; which is a farther Proof, that if it cannot move compleatly round the Circuit, it then does not move in any Part of it.

N. B. Second, It ſeems abſolutely neceſſary to remember, that great Facility by which this ſubtile Fluid moves through all denſe non-electrical Bodies into the Earth*, ſo clearly proved by the Obſervations on the ſecond capital Experiment in my former Eſſay, Page 22, and repeated in this at Page 46.

To apply the foregoing Reaſoning, Firſt, Since the grand Exploſion which generates the Force, and propagates the Shock, is by the Help of Dr. *Bevis*'s Saſh Pane, traced to the inner Surface of the Vial †.

Secondly, That a Vacuum is there formed by the ſudden Expanſion, which was exemplified, by conſidering the Vacuum formed at the Firing of a Gun, and illuſtrated by the Experiment of the Ciſtern of Water and leaden Pipe ‡.

Thirdly, The Readineſs, as well as the great Facility of the electrical Fluid to pervade the Glaſs, and arrive at the Vacuum, as appears by Mr. *Hawkſbee*'s Experiment §.

And, Fourthly, We are informed by Experience, that the Effects of the *Leyden* Experiment are nearly the ſame, whether the Circuit be long or ſhort, regular or irregular.

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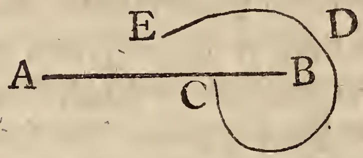
* From the Effects of the *Leyden* Experiment, the like Propenſity is obſerved of moving through all denſe non-electrical Bodies throughout the Circuit to reſtore the Vacuum, formed by the ſudden and violent Expanſion at the Exploſion or burſting forth of the electrical Fire, whether at the Gilding on the Inſide of the Vial, or the Gilding at the electriſed Surface of the Saſh-Pane.

† Page 111. ‡ Page 87. 89. § Page 94.

Quæry. From theſe Premiſes, together with the Effects, we obſerve, May we not ſafely conclude, that the violent Expanſion generates a Vacuum? Secondly, That the Vacuum is as inſtantly ſupplied through the thin Glaſs *, with Æther from the undermoſt Hand: Thirdly, This again as inſtantly ſupplied from the whole Circuit; and the whole Circuit of Æther hurried on by the firſt Expanſion at the electriſed Surface of the gilded Pane.

That this may appear more plainly to the Underſtanding,



Let AB repreſent the Length or Breadth of the Square, or the Diameter of the circular Pane of Glaſs: CDE a circular Wire: The End C communicating with the Gilding at the under Side of the Pane.

Whenever the Gilding at the upper Surface of the Saſh-Pane is electriſed, it does not readily depart from it; but when let alone to itſelf, frequently remains for a very conſiderable Time after, cloſely ſurrounded and guarded on all Sides by Electrics *per ſe*, *viz.* the circumambient Atmoſphere and the Glaſs; but no ſooner is one End of the non-electrical

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* For, as was before obſerved, the Experiment will not ſucceed if the Glaſs exceed a certain Thickneſs.

electrical Circuit (in this Experiment, the End E of the circular Wire) brought near it, but it breaks forth from its confined State, and darts with the utmoſt Violence into it, leaving a Vacuum behind it; which is as inſtantly reſtored through the Glaſs of the Pane, from the other End C of the Wire, and this again as inſtantly ſupplied from the electrical Fluid in the Circuit, which ruſhes like a Torrent, and follows it.——Thus, all to Appearance, is performed in the ſame Moment of Time, and with the ſame Impetuoſity throughout the whole Circuit (although ever ſo greatly extended) as at the very Part where it began; and to uſe Mr. *Franklin*'s Expreſſion, "Each Particle puſhes its Neighbour quite to the farther End."

I am very ſenſible, that after all that can be ſaid on this abſtruſe Phænomenon, it muſt be eaſier from the Premiſes juſt laid down, to form a much clearer Idea of the Manner the circulating Shock is produced, and propagated, than from a Multiplicity of Words only, although as compleatly explained as the preſent Deſcription falls ſhort of it; for my own Part, I am conſcious of nothing compleatly performed, but a ſincere Endeavour of diſcovering what might be ſome Way or other uſeful, and of communicating the ſame in an intelligible Manner.

If it be replied, that after all this Point ſeems to be laboured: It may be anſwered, I know not one Thing in the Premiſes that can be ſpared, or that is not abſolutely neceſſary to explain the Appearance, ſo as that it may ſeem tolerably clear, and conſequently, that ſo far I have not exceeded Sir *Iſaac Newton*'s firſt Rule of Reaſoning. Does it not ſeem agreeable to Reaſon to ſuppoſe, from Mr. *Franklin*'s Experiments,

Firſt, That the electrical Fluid is detained at the Junction of the Gilding on the Glaſs? Secondly, From other Experiments, that at the Approach of the End E of the circular Wire, it explodes and ruſhes into the ſame Wire, leaving a Vacuum; which is, Thirdly, as inſtantly ſupplied through the thin Glaſs from the lower End C of the circular Wire? And, Fourthly, Does it not appear from the Effects of thoſe Kinds of Experiments, that the electrical Fluid moves through all Circuits in the very ſame Manner, whether they are long or ſhort, regular or irregular?——Can one of theſe Premiſes be wanting, and yet the whole ſeem agreeable to Reaſon and Experience?

Laſtly, Concerning the Uſefulneſs of the electrical Fluid, when applied as a Remedy to human Diſeaſes and Maladies.

HERE it muſt be owned, thoſe Gentlemen Inquirers have ſhewn an Air of recommending to the Public the Peruſal of my Performance; but whether by a real Deſign of ſo doing or not, may perhaps more plainly appear, by conſidering the Way and Manner in which they delivered their Sentiments.

ANIMADVERSIONS.

But his Book may, at leaſt, be of as much Advantage to Society, as many others that are written in a more ſcientifical and more elegant Manner; the removing thoſe Diſtempers to which human Nature is ſubject, being of infinitely greater Conſequence than many of our moſt refined philoſophical Speculations.—Of this Application of Electricity, the Author has treated very fully, enumerating the Cautions neceſſary to be obſerved, in order to render the electrical Shocks uſeful; obviating the ſeveral Objections made to the medicinal Uſes of Electricity, and accounting for the Miſcarriage of the ſeveral Attempts of that Kind made by others.—The following Inſtances will ſhew what Succeſs he has had in curing Diſeaſes by Electricity.

REMARK.

Then, to ſhew what Succeſs I had had, they tranſcribe out of the whole Number four of the Caſes only, namely, 14th, 19th, 30th, 31ſt; and this, without ſo much as giving the Reader the leaſt Hint that he was to expect any more; then, conſequently, if he was to expect no more of thoſe Applications, and the Pamphlet written in ſo mean and deſpicable Language, by one intirely ignorant in Philoſophy, it might well be preſumed, few would think it worth the Peruſal.

I am not ſo vain, or ſo unreaſonable, as to expect them to have tranſcribed every Caſe; but if they had really deſigned to give it a Character ſufficient to recommend it, it might have been expected (at leaſt) to hear them inform their Readers, that in the Book itſelf they would meet with many more Applications of the ſame Kind, equally remarkable; this was the leaſt they could have ſaid, had they deſigned to recommend the Peruſal.

Then follows: ——— *And we could wiſh they would excite others to make Experiments of the ſame Kind, that it may be finally determined, whether Electricity may, or may not, be rendered uſeful in medicinal Intentions.* *Quæry*, Can it indeed ſtill be reaſonably queſtioned, whether there is any juſt Grounds for believing that Electricity may be rendered uſeful in that Way.

Had this Account, under Inſpection, of curing Diſeaſes by Electricity, come from any remote Corner, there might have been ſome Reaſon to doubt, whether the Facts therein-mentioned were genuine ; but can it ſeem probable, that I ſhould think to impoſe on the whole City in which I dwelt, in ſo groſs and barefaced a Manner, as I muſt had there been no ſuch Cures wrought.

Muſt it not appear very extraordinary, that I ſhould think of publiſhing ſuch a Variety of them in a Pamphlet prepared for the ſame Purpoſe, where the Names of ſo many of the Patients were prefixed, moſt of them on the Spot, or near at Hand, ready to detect the Fraud, had it been ſuch, and yet, that I could think of doing all this with Impunity: This muſt appear at firſt Sight too inconſiſtent to be admitted, and conſequently Electricity may be rendered uſeful in medicinal Intentions; or elſe what would appear a downright Contradiction, *viz.* that all the Cures mentioned in my Pamphlet, and many Hundreds beſide, not written down *, were the Effects of mere Chance, notwithſtanding many of them were ſure to happen, whenever thoſe Experiments were applied in particular Diſorders; for I can aſſure the Reader, in many Caſes it ſeldom or never fails.

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* Since I publiſhed that Eſſay, Mrs. *Cox*, a Gentlewoman of *Birmingham*, who had made Uſe of Electricity for a Kind of pleuretic Complaint, ſeemed a little out of Humour becauſe ſhe did not find an Account of her own Caſe in my Cata-

In a Word, I can truly ſay I ſcarce ever knew any who attempted Trials of this Kind that did not ſucceed; and conſequently, if thoſe Gentlemen or others would but repeat ſome of the ſame Experiments, and in the ſame Manner as I have directed at the End of each particular Caſe in that Eſſay, they would meet with equal Succeſs.

N. B. I would not be underſtood to mean, that all Diſorders, in all Trials, yield alike to thoſe electrical Applications, for different Diſorders yield differently; and even the ſame Treatment of the ſame Diſorder, in different Perſons, will not be attended with equal Succeſs, any more than when treated in the common Way.

But notwithſtanding the Succeſs which attended thoſe electrical Applications, yet, from eight or nine ſucceſſive Years of Experience, I could never obſerve any abſolute

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Catalogue of Cures.——I told her my Reaſon for it was, I did not think it a Cure ſufficiently remarkable; ſhe replied, ſhe thought it a very great one, as ſhe could have no Relief from other Means, or to the ſame Effect.

Many beſides have greatly extolled Cures performed on them, which yet I did not think were worthy to be ranked with the reſt.

healing Quality in the electrical Fluid, unleſs an Attenuation of the bodily Fluids, and that which promotes a free Circulation, may be allowed to be ſuch.

Being ſome Time ſince in Company with an ingenious Gentleman of the Faculty, and the Converſation turning on the Subject of Electricity, and the many and various Cures which had been effected by Means of thoſe electrical Applications, he aſſured me, it had been the Opinion of ſome very eminent Phyſicians, that there was, in Nature, ſuch a Thing as a real Panacea; and if ſo, it was his Opinion, that Electricity bid as fair for it as any Thing: And although an abſolute Catholicon muſt, in the Nature of Things, be impoſſible, yet that which proves a Remedy in the greateſt Variety of Complaints, muſt, as he juſtly obſerved, be allowed to lay in the faireſt Claim to it.

But nothing can be more certain, than that neither the electrical Method of treating Diſorders, or any other can be expected to arrive at any conſiderable Degree of Perfection, till adminiſtered and applied by thoſe learned Gentlemen of the Faculty, who, having a thorough Knowledge, not only of the Structure of the human Body, but the various Diſtempers incident thereto, with their ſeveral Cauſes, muſt be the only Hands from which we can expect the greateſt Succeſs in either.

N. B. Sudden as well as acute Pains are, for the moſt Part, inſtantly cured by thoſe electrical Applications.

* * *

POSTSCRIPT.

IF I have been hitherto miſtaken, in ſuppoſing thoſe Gentlemen Enquirers Strangers to Electricity; and, if I have been guilty of any material Errors, which I am at preſent not ſenſible of, I ſhould be very thankful if they would condeſcend to correct ſuch Errors in a candid and good-natured Manner: Since all will allow the Subject to be highly worthy of Conſideration, and as I can think of no Method ſo effectual, to clear up any doubtful Part of it, as a candid Controverſy, ſo I ſhall gladly return as candid an Anſwer, and retract whatever appears erroneous.——I am the leſs apprehenſive of any material Error appearing, becauſe I can truly ſay, that what I have delivered has been firſt faithfully examined, and proved by Experiments; ſo that whatever Objections may be made to it, I hope to meet with civil Treatment, whether ſuch Objections may come from thoſe Gentlemen themſelves, or, *under Colour*, from their Agents; for I ſhould be very ſorry, if a Subject of ſuch Importance, ſhould, inſtead of being fairly controverted, end in a wrangling Diſpute after Captures and Repriſals made, *viz.* Alternate Detraction and Cavilling, which is very often the Caſe. And,

As it is entirely out of my Power to palliate and gloſs over the Subject, and make that appear true which is in reality falſe, ſo an Error may be the more eaſily detected: 'Tis preſumed the having delivered my Sentiments in plain Language, is no real Diſadvantage to the Subject, provided my Meaning be ſufficiently intelligible; for is it not generally allowed, that many Things which have been written in a florid Style, and in a pompous Manner, have, inſtead of illuſtrating the Subject they were pretending to explain, rendered it the more obſcure and unintelligible, by artfully blending Truth and Falſhood in ſuch a Manner as to confound each other, ſo as not without ſome Difficulty to be diſtinguiſhed by the Majority of

Readers; conſequently, whenever a Subject appears myſterious, a plain intelligible Manner of treating it, is preferable.

Permit me to conclude with that humble Requeſt of the illuſtrious Sir *Iſaac Newton*, which, although in him it might well have been ſpared, yet a more modeſt one cannot well be exhibited for the moſt defective Performance, even for this of mine.

> " I heartily beg that what I have here " done, may be read with Candour, and " that the Defects I have been guilty of, " upon this difficult Subject, may be not ſo " much reprehended as kindly ſupplied, and " inveſtigated by new Endeavours of my " Readers." Preface to his *Princip.*

FINIS.

Juſt publiſhed by the ſame Author,

THE

SUBTIL MEDIUM PROVED,

OR, THAT

Wonderful POWER of NATURE,

So long ago conjectured

BY THE

Moſt Ancient and Remarkable Philoſophers,

Which they called ſometimes

ÆTHER,

But oftener

ELEMENTARY FIRE, VERIFY'D.

SHEWING

That *all* the *diſtinguiſhing* and eſſential Qualities aſcribed to ÆTHER by them, and the moſt eminent modern Philoſophers, are to be found in ELECTRICAL FIRE, and that too in the utmoſt Degree of Perfection.

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But alſo accounting

Firſt, For the natural Difference of electrical and non-electrical Bodies.——*Secondly*, Shewing the Source or main Spring from whence the electric Matter proceeds.——*Thirdly*, Its various Uſes in the animal Œconomy, particularly when applied to Maladies and Diſorders incident to the human Body. Illuſtrated by Variety of known Facts.——*Fourthly*, The Method of applying it in each particular Caſe. And,——*Laſtly*, The ſeveral Objections brought againſt it accounted for and anſwered.

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4.

LETTRE ELECTRIQUE

SUR LA MORT DE M. RICHMANN.

par M. Rabiqueau.

LETTRE

SUR LA MORT

DE M. RICHMANN,

PROFESSEUR A PETERSBOURG,

Tué par le Tonnerre, en faiſant ſes Expériences Electriques avec la relation de cette fatale Hiſtoire, dont on donne la cauſe Phyſique; & celle de tout le Phénomene, & comment s'engendre le Jour, les Saiſons, les Eclairs, le Tonnerre; enfin pourquoi ce dernier cauſe tant d'accidens.

VOUS me marquez M. que vous ne venez que d'apprendre que j'ai donné un traité ſur l'explication & la cauſe Phyſique de tous les Phénomenes de l'Electricité, & ſur l'abus des pointes pour détruire le Tonnerre, & vous me priez de vous en envoyer 20 Exemplaires, pour des Mrs de votre Academie, qui ont oüi dire que M. Richmann n'eut pas été tué, s'il eut connu ce Livre nouveau.

L'Hiſtoire Tragique de M. Richmann merite bien qu'on plaigne ſon ſort, en louant ſon zèle, mais on ne peut s'empêcher de le regarder comme téméraire, d'avoir agi ſur la foi des Sectateurs des pointes, ſans connoître la valeur de ſon entrepriſe.

La Gazette d'Allemagne nous a fourni une relation qui me paroît aſſez exacte, ſur les circonſtances de cette mort, quoiqu'il y ait un peu de confuſion, dans ce qu'elle dit de la poſition de l'Eguille de l'Electricité, avec la barre & le vaſe, dont la communication n'eſt pas indiquée trop clairement; mais qu'on ſuppoſe aſſez pour les effets. C'eſt d'après cette relation que je vais vous donner une explication de ce Phenomène; la cauſe en eſt évidemment demontrée dans le Traité que je vous envoye, lorſqu'on en fera une juſte application.

ALLEMAGNE.

De Hambourg le 14 Septembre 1753.

On voit ici une relation circonſtanciée du tragique accident arrivé à M. Richmann, Profeſſeur à Petersbourg, lequel fut tué d'un coup de foudre le 6 du mois dernier, en faiſant ſes Expériences Electriques ſur le Tonnerre.

LE 6 Août vers le midy, M. Richmann voyant un orage s'élever du côté du Nord, ſe diſpoſa à continuer ſes Obſervations: il y avoit avec lui M. SOKOLOW *Graveur de l'Academie. L'endroit où il faiſoit ſes Expériences étoit une eſpece de galerie longue de 16 pas ſur 4 de large, ayant ſon entrée vers le Nord, & une fenêtre du côté du midy. On ne ſçait ſi cette fenêtre étoit alors ouverte ou non, tout ce qu'on peut dire avec certitude, c'eſt qu'il y avoit près de la fenêtre une armoire de la hauteur* *de 4 pieds ſur laquelle on avoit fixé l'aiguille de l'Electricité, & poſé un vaſe de verre rempli en partie de limure de cuivre jaune dans lequel deſcendoit une barre de fer de l'épaiſſeur d'un doigt & de la longueur d'un pied, au haut de cette barre on avoit attaché un fil d'archal qui deſcendoit du toît de la maiſon, & entroit par le haut de la galerie.*

Le Profeſſeur jugeant à l'aiguille que l'orage devoit être fort éloigné, aſſura M. SOKOLOW *qu'il n'y avoit point encore de danger, mais qu'à l'approche de l'orage il pourroit y en avoir; M. Richmann ſe tenoit à la diſtance d'un pied de la barre de fer, continuant d'obſerver attentivement l'aiguille: le Sieur* SOKOLOW *vit quelques momens après, ſans qu'on eut touché à la Machine, un globe de feu bleu & blanchâtre d'environ 4 pouces de diametre, ſortir de la barre de fer & frapper le front de M. Richmann, qui, ſans jetter le moindre cri, tomba à la renverſe contre le mur; à ce Phénomene ſuccéda un coup comme celui d'un petit canon.*

Le Sr SOKOLOW *en fut renverſé par terre & ſentit quelques coups, comme ſi on l'eut frappé ſur le dos: on a reconnu depuis, que le fil d'archal s'étant rompu, les morceaux de ce fil l'avoient atteint, & avoient laiſſé des traces de brûlure ſur ſon habit. Après être un peu revenu de ſon premier ſaiſiſſement, il ſe releva; & s'appuyant d'abord contre l'armoire, il jetta la vûe du côté de M. Richmann qu'il ne croyoit qu'étourdi du coup: une épaiſſe fumée l'empêchoit de lui voir le viſage, & lui fit appréhender que le feu n'eut pris à la maiſon. Il ſortit de la galerie tout effrayé, & appella le piquet de la Garde. Madame Richmann qui avoit entendu le coup, vint à la galerie qu'elle trouva remplie de fumée: M.* SOKOLOW *venoit d'en ſortir. On peut s'imaginer* *la douleur & la conſternation de cette Dame, lorſque ſe retournant elle vit ſon Epoux étendu ſur le dos ſans donner le moindre ſigne de vie : elle eut d'abord recours aux ſels, aux liqueurs, & à tout ce que ſon extrême agitation lui permit d'employer pour tâcher de retirer ſon mari d'un état que ſa tendreſſe lui repréſentoit comme une eſpece de léthargie. Tout fut inutile, elle ne put jamais lui faire reprendre ſes eſprits.*

Le Profeſſeur Kratzenſtein s'y rendit 10 minutes après avec un Chirurgien, qui ouvrit la veine à M. Richmann; mais il n'en ſortit qu'une goute de ſang; & on ne lui ſentit plus de pouls. M. de Kratzenſtein tenta inutilement de lui ſouffler à diverſes repriſes dans la poitrine, comme on a coutume de faire aux perſonnes étouffées. Cependant on ne lui vit aucune marque de convulſion, ni aux bras ni aux jambes, &c. Mais on remarqua à la partie ſupérieure du front, où les cheveux commencent une tache rouge ovale de la grandeur d'un rouble, tirant un peu ſur le côté gauche, où le ſang avoit été comprimé ſans que la peau fut aucunement offenſée. Le ſoulier du pied gauche s'eſt trouvé déchiré en deux endroits du même côté ſans aucune marque de brûlure; à côté des déchirures, on apperçut de petites taches blanches. Lorſqu'on l'eut déchauſſé on trouva au même endroit une tache de ſang extravaſé grande comme un rouble. En examinant le corps, on remarqua au côté gauche, depuis les hanches juſqu'au coû, huit taches rouges & bleues, tant groſſes que petites outre quelqu'autres qui reſſembloient à celles que la poudre à canon fait en brûlant la peau. On viſita enſuite la galerie. Un éclat de la porte de la cuiſine, long de deux pieds, & de la groſſeur d'un tuyau de plume, avoit été jetté ſur les dégrés de l'eſcalier, qui y étoit contigu. Le vaſe de verre étoit caſſé juſqu'à la moitié de ſa hauteur, & la limure de cuivre diſperſée ainſi que quelque petits morceaux de fil d'archal.

Le lendemain ſur les inſtances de l'Academie, le Profeſſeur Kratzenſtein & le Sr Klein, ſon adjoint en Anatomie, firent l'ouverture du corps 24 heures après l'accident. D'abord on remarqua que les taches de ſang extravaſé s'étoient ſechées & endurcies ſans que le poil eut été brûlé : on enleva enſuite la peau & l'on trouva que les taches loin de pénetrer juſqu'aux muſcles & aux os, &c ; ne paroiſſoient pas même ſur la graiſſe qu'elles couvroient. La cervelle n'avoit rien ſouffert. La partie antérieure du poumon étoit auſſi dans ſa ſituation naturelle entre le mediaſtin & les côtes, ſans aucune bleſſure : le cœur n'étoit point non plus offenſé, mais il ne s'y trouva point de ſang. La partie poſtérieure du poumon particulierement du côté droit étoit noirâtre, & toute couverte de ſang extravaſé : dans le creux de la poitrine, il y avoit environ une demi-livre de ſang pur ; en ſéparant la trachée d'avec l'orifice du ventricule, on en trouva la partie poſtérieure extrêmement molle, mince & déchirée : les branches de l'artère étoient remplies de ſang, partie clair, partie écumeux. Avant d'ouvrir le corps, & lorſqu'on le tourna, il en étoit ſorti un peu de ſang par la bouche. Les inteſtins grêles étoient ſains & en bon état, mais le pancreas étoit bleſſé & rempli de ſang : le reſte des entrailles, comme le foye, la rate, &c. étoient auſſi ſains qu'on puiſſe les avoir.

Quant à l'accident même, le Profeſſeur auroit pu demeurer encore quelque tems dans la galerie ſans paſſer pour téméraire ni courir naturellement aucun danger, puiſque l'orage étoit encore éloigné de près de 6 degrés de ſon horizon : au moyen des 5 ou 6 coups qui l'ont précedé, & qui étoient fort foibles, *on en a pu aiſément calculer la diſtance par l'intervalle de 15 à 20 ſecondes entre l'Eclair & le Tonnerre qui tua M. Richmann.*

Le Conſeiller Lomonoſſow faiſoit une pareille expérience chez lui tout proche de la maiſon de M. Richmann, & il ne remarqua que de groſſes étincelles dans le tems même que ce coup fut ſi funeſte au Profeſſeur.

Pour pouvoir ſentir la force de cette explication, il faut d'abord avoir attention de ne rien donner au préjugé, au contraire il faut rigoureuſement s'attacher aux faits conſtatés par l'expérience, & ne point perdre de vûe la diſtinction du feu ordinaire, qui eſt en action avec l'air ſur la matiere, d'avec celui de l'Electricité ou du Tonnerre, qui n'eſt que l'eſprit de feu pur ſans aucun air, cet air étant alors toujours écarté à la circonférence, Chap. 2. *Idée du Méchaniſme de l'Univers pour parvenir à celui de l'Electricité*, *pag.* 13 &c. de mon Traité du Spectacle du Feu Elémentaire.* Ceci bien entendu, on paſſera au chap. V. 6e. effet, pag. 125 & 126. Ch. VII. ſect. 4 §. 20 juſqu'à 30, p. 215, 216 & 217.

Voici le Titre de cet Ouvrage.

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* Le Spectacle du feu Elémentaire, ou Cours d'Electricité expérimentale, où l'on trouve l'explication, la cauſe & le Méchaniſme du Feu dans ſon origine, de-là dans les corps, ſon action ſur la bougie, ſur le bois, & ſucceſſivement ſur tous les Phénomenes Electriques ; où l'on dévoile l'abus des pointes pour détruire le Tonnerre : on y explique en outre la cauſe de la chûte des corps au centre de la Terre, celle de l'aſcenſion de l'eau dans les tuyaux capillaires, &c. Que le Feu eſt le reſſort, & l'air l'agent du Méchaniſme de l'Univers. Par M. CH. RABIQUEAU, Avocat, Ingénieur Privilégié du Roi, pour tous ſes Ouvrages de Phyſique & de Méchanique. Les Libraires le trouvent à Paris, chez l'Auteur, *Hôtel de Mouy, rue Dauphine, près le Pont-Neuf*, où l'on fait les Cours compoſés de plus de 60 Expériences nouvelles, & 16 de comparaiſon qui ſont partie du Traité, qui ſe vend auſſi chez Jombert Libraire du Roi, pour l'Artillerie & le Genie, *rue Dauphine à l'Image Notre-Dame, & au Palais* chez Grangé Libraire, gallerie des Priſonniers.

Pour plus d'intelligence je reprens ici l'origine du Tonnerre, juſqu'à ſa réunion à l'équilibre avec l'air ; j'eſpere que vous me ſçaurez bon gré de vous éclaircir ſur cette matiere : le développement en eſt curieux & intéreſſant.

Les effets non-ſeulement nous mettent en état de conjecturer, mais même ils nous aſſurent que l'Auteur de la Nature ayant formé les quatre Elémens, (ch. 2 pag. 13, &c.) celui du Feu a été le premier, l'Air le ſecond, dont chaque globule a reuni à ſa matiere autant d'eſprit de feu qu'il en peut contenir, comme l'eau fait ſur le vin ; la Terre & l'Eau ſont une matiere ou des corps formés dans ce ſecond Elément ; ils ſont imbus des globules d'eſprit d'air & d'eſprit de feu (on dit d'eſprit, parce qu'étant dans les pores de ces Corps, ils ſont dégagés de tout Atôme, inſecte,&c. & autres matieres qui ne s'y aſſemblent point, comme dans l'air groſſier que nous reſpirons). L'équilibre a fixé ces Elémens à raiſon de leur péſanteur, & c'eſt l'ordre naturel. Mais le Méchaniſme demande une circulation continuelle qui nous amene le jour, la nuit & les differentes ſaiſons : où eſt la ſource de ce Méchaniſme? comment le comprendrons-nous ? qui en ſera la force motrice ? Le feu & l'air agiſſant ſur la matiere terreſtre.

Le feu ayant été amalgamé avec l'air, autant que ce dernier en a pu contenir, le premier étant bien plus étendu,il eſt reſté un Globe formé de cet Excedent réuni,qui eſt le Soleil, tout eſprit de feu,le feu pur, Corps extrêmement léger par la ſubdiviſion inombrable de ſes pointes, & dont l'union totale porte la chaleur, le feu de vie, la lumiere ſur tout ce qui l'environne. Or, ce Globe de feu communique, donne à ſon lever la lumiere & le feu à chaque globule d'air & de feu réunis, qui forment autant de rayons ſolaires, tous ſe le communiquant les uns aux autres, enfin juſqu'au centre de la Terre & au fond de l'Eau. Ainſi arrivé à la matiere terreſtre, celle-ci étant diviſible lui préſente autant de canaux que de pores, à la faveur deſquels le feu acquiert une action, qu'il exerce ſur cette matiere, où il prend ſon cours, comme par autant de Siphons, à meſure que l'air s'y inſinue pour en remplir les vuides, ce qui ne ſe peut faire que par dégrés, & le plus ou le moins de domination & d'éloignement du ſoleil; d'où naiſſent les ſaiſons.

Saiſiſſons ces faits, la Terre en recevant la lumiere, & l'action des rayons ſolaires au premier inſtant de l'origine du Soleil, n'a pu être échauffée que par dégré, & à meſure que le feu a fait du progrès, en déſſechant les matieres; ce qui demande un tems que nous pouvons comparer au Printems; pendant lequel l'action ſolaire eſt inſinuante & douce comme à ſon lever, & agit modérement ſur les corps & les matieres que l'air plus condenſé reſſerroit. Ces Corps ayant acquis en eux l'action du feu à un certain dégré; il s'en exhale d'autant plus de parties, qui réunies nous produiſent enfin l'Eté, le Soleil étant dans ſon plus haut dégré: de même que chaque jour il nous donne la chaleur du midi; s'abaiſſant enſuite ſur l'horizon il laiſſe la liberté à ces colonnes de feu de s'exhaler par la preſſion de cet air, qui s'inſinue d'autant, pour remplir la place, à meſure que la matiere ſe conſume; alors ſe trouvant plus d'air que de feu, la chaleur décline, c'eſt l'après-midi, ou l'Automne. Ces Corps dilatés, ces méches deſſechées deviennent à rien, & n'exhalent preſque plus de feu: la matiere ne reſiſte plus, elle rentre dans le repos ; l'action de vigueur ceſſe, plus de chaleur, c'eſt le ſoir, enfin l'Hyver. Cette méche ou matiere étant conſommée, l'équilibre ſe retablit, l'air, le feu & la matiere ſont remis à leur premier état : le Soleil recommence à s'inſinuer ſur la Terre, où trouvant de nouvelle matiere, il agit de nouveau, & ſucceſſivement, redonne le jour, & toutes les ſaiſons.

Il eſt maintenant aiſé de comprendre qu'en Eté le feu s'élevant de tous côtés, en ſortant abondamment des Corps & des Matieres, il ſe réunit aiſément en volume capable de réſiſter malgré ſa légéreté, à l'air environnant, qui tend à comprimer & à reprendre l'équilibre, tant que cet air ne trouve aucune iſſue pour s'inſinuer & diviſer ce feu reuni. l'Expérience du paſſe-vin nous en fournit un exemple aſſez ſenſible (pag. 75, 90 & 91.)

Ce nuage de feu ſe ſoutenant ainſi, & agité par les nues, s'allie à un autre ſemblable, & leur union ſe fait avec une lumiere rouge, ſans bruit. Chap. VII. §. 29. p. 216.

Ce nuage de feu ſouvent enveloppe & s'unit en cercle au tour d'un nuage d'eau, ou d'un nuage d'air ordinaire, ainſi ce nuage eſt électriſé, c'eſt-à-dire environné de feu.

Un autre en enveloppe un autre ; ces derniers ſe rencontrent d'où naiſſent les éclairs, d'un rouge bleuâtre, avec bruit, (§. 29 & 30 pag. 216 & 217) même ch. L'air pourſuivant continuellement les parties du feu juſqu'à la réunion à l'équilibre, néceſſaire pour le Méchaniſme, forme les vents, les ouragans, les nuages de pluye & de grêle cauſés par les parties de feu plus ou moins dominantes, & les differentes chutes des uns aux autres, enfin le Tonnerre.

Cette foudre échappée de ſon nuage, eſt pouſſée par les colonnes d'air environnant en tout ſens, celle qui repond à un Corps non électrique, où l'eſprit de feu & l'eſprit d'air ſont en concurrence, eſt la plus foible à ſon égard, & où il a plus d'aptitude à ſe rendre, ſi il ne trouve aucune force qui le rejette & l'oblige de s'élancer ailleurs: en ce cas, l'objet ſur lequel il s'élance, eſt ſujet à être brûlé; mais ſi ce feu eſt diviſé en Atmoſphere, au tour d'un nuage fort étendu, en entrant en charge ſur les nuages avoiſinans, il perd beaucoup de ſa force, & en ce cas, ſouvent il ne brûle point; mais l'objet qui ſe préſente pour ouvrir un canal à ſa réunion, eſt déchiré & briſé par la ſécouſſe de l'air rentrant en équilibre. pag. 218 même chap. §. 32. où l'on voit l'explication des effets de la foudre qui tomba ſur le clocher des grands Auguſtins en 1747.

Examinons à préſent ce qui s'eſt paſſé au reſpect de M. Richmann; ſuivant les faits, le nuage de la foudre étoit étendu, pluſieurs pointes électriques perçoient dans ce nuage; ces barres ſemblables à d'autres nuages capables d'être électriſés, s'électriſerent effectivement, & formoient à leur égard autant de nouvelles Atmoſpheres, qui ne tendoient qu'à s'écouler par le premier canal qui ſe préſenteroit.

Le vaſe de verre rempli de limaille a été l'inſtrument funeſte qui a occaſionné tout le malheur. Ce vaſe ayant reçu d'abord une premiere charge au deſſus de la limaille, avoit une Atmoſphere bien ſupérieure à celle d'une ſimple barre, chap. 6, 2e effet pag. 138, &c. L'armoire operoit le courant du Feu ou de la Matiere Electrique par le plancher; comme M. Richmann a préſenté un canal de réunion, de l'Atmoſphere du verre avec l'écoulement qui repondoit à ſon pied, c'étoit le chemin le plus court pour reprendre équilibre, tel que je le démontre dans une Automate Electrique que j'ai imaginé pour mes Expériences & Cours. Cette figure admirable ne frappe point celui qui porte ſon doigt au doigt de la figure, quoiqu'il tienne la chaîne qui communique aux pieds de cette figure, & qu'il établiſſe un courant par les deux extrêmités : parce qu'un autre objet établit un courant plus court par un éclair d'une ſinguliere beauté ; interrompt-on ce courant intérieur ? alors celui qui porte le doigt eſt frappé, & reſſent une bonne commotion. Cette figure heriſſe des rayons pendant la charge, ce qui prévient qu'on doit être frappé : il n'y a aucuns rayons quand le courant eſt intérieur. *

M. Richmann n'a pu réſiſter au paſſage du feu réuni par les deux bouts ; ce feu en paſſant s'eſt allié le feu de vie de M. Richmann, en écartant en même-tems l'air, de ſorte qu'il n'eſt reſté que la matiere incapable de vie, ſans ce feu & cet air. Les differentes taches de ſang extravaſé, ſeché & coagulé, écumeux, ces parties bleſſées & déchirées, ſont les ſuites de l'interruption de ſon action & de la répulſion de l'air pendant ce courant de feu arrivé par le pied & par le front, dont la réunion eſt ce que nous appellons commotion, à cauſe de l'action du feu réuni ; auſſi le choc, l'effort le plus violent ſe marque-t'il au corps au lieu de la réunion du feu & de l'air.

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* Comme mon cabinet privilégié du Roi, *Hôtel de Mouy rue Dauphine*, eſt un Spectacle toujours ouvert au Public, on peut pour trois livres par repréſentation, voir à ſon gré tel Phénomene, ou Piéce Méchanique que l'on ſouhaite.

La fumée épaiſſe n'eſt probablement venue que de la limaille de cuivre, ou le feu a fait effort au moment de ſa réunion ; ce feu n'a laiſſé qu'une fumée, n'ayant pu agir que ſur les parties ſpiritueuſes, ſulphureuſes qu'il a entraîné en briſant le verre & le fil de fer, au moment de la réunion de l'air à l'équilibre. Les éclats de ce fil de fer qui ſe ſont lancés de côtés & d'autres, ont diviſé & affoibli beaucoup l'Atmoſphere ; chacun de ſes morceaux de fil de fer, de ſes parcelles de limailles, &c. ne recevant plus de charge de la barre, de l'orage, ne pouvoient porter que le coup du ſimple contact, & non d'une réunion du feu.

Ce contact violent a renverſé M. Sokolovv, qui venoit de voir la chute du feu ou éclair que M. Richmann avoit reçu : M. Sokolovv avoit encore entendu le coup de la commotion ou réunion de l'air, qui avoit fait le bruit d'un petit canon, par le rétabliſſement à l'équilibre, & le froiſſement de l'air contre l'air ; dont le coup eſt ordinairement d'autant plus grand, qu'il y a eu de vuide ou de feu échappé ; il n'a pas été renverſé par cette commotion, mais par le violent contact que l'Atmoſphere du fil de fer a occaſionné en faiſant couler le Phénomene au tour de lui ch. V. 6e. effet pag. 100, &c. Comme ce Phénomene a trouvé une iſſue, M. Sokolovv n'a eu que le coup du remplacement de l'air, que ce Phénomene avoit ſoulevé autour de lui. Quant à la brûlure, ce fil de fer mince avoit été froiſſé & preſque brûlé par la violence du contact. Dans ſa rupture, il a conſervé aſſez de feu pour efflérer & marquer la trace de ſa chute ſur l'étoffe.

L'éclat qui eſt ſorti de la porte de la cuiſine eſt encore un débris du ſimple contact & non de la commotion; quelque trait de Feu Electrique s'étant attaché & ayant pris cours par cette porte, les parties d'air écartées ont briſé ce morceau ; le reſte du feu bien affoibli s'eſt trouvé enfin réuni à l'équilibre.

Voici la cauſe de ces terribles effets par des principes ſûres, relativement au Traité que je vous envoye. C'eſt mal-à-propos que les Auteurs de la relation diſent que M. Richmann auroit pu encore demeurer quelque tems dans la galerie, parce que l'orage étoit éloigné, au moyen des 5 ou 6 coups qui ont précedé. Leur calcul Géometrique n'eſt point à raiſon du fait, ni en raiſon Electrique ; parce que ce n'eſt point l'effet d'aucuns de ces 5 à 6 coups de Tonnerre, mais de celui de l'Atmoſphere & charge du vaſe, dont l'Eclair, l'étincelle & le coup ont été occaſionnés par M. Richmann, qui préſentoit, avons-nous dit, un chemin plus court à la réunion du feu en charge au verre.

Le Conſeiller Lomonoſſovv n'a eu que des étincelles à ſa barre, cela eſt naturel, il préſentoit toujours un écoulement à la Matiere Electrique ; il n'étoit ſujet qu'aux contacts plus ou moins violens, ſuivant la charge ; au lieu que dans la commotion, le feu arrivant des deux bouts, force, paſſe au corps, & tend à s'unir comme je l'ai démontré ch. 6 ci-deſſus ; en outre on ne fait pas mention de la charge d'une bouteille chez ce dernier. Il pourroit encore y en avoir eu une, & que l'écoulement ſe fut fait par ailleurs. Sans cela 10000 perſonnes dans l'eſpece de Monſieur Richmann, & à la fois, n'échapperoient jamais à une pareille commotion, dont la force n'eſt relative qu'à l'Atmoſphere accumulée au verre, qu'il étoit très-imprudent d'expoſer à la charge d'une Machine bien au-deſſus de la force de l'Electricité ordinaire : c'eſt-là le cas des accidens funeſtes qui arrivent, ſans quoi la nuée chargée d'Electricité, eut pu ſe perdre ſans faire aucun mal, en trouvant un écoulement ſans réunion, comme il arrive fort ſouvent.

Si M. Richmann eut eu à ſa main un fil de fer, portant d'un bout ſur ſa cuiſſe, & dont l'autre bout eut été à portée d'ouvrir un canal à l'Eclair Electrique, il eut pû être ſauvé ch. *6* pag. 189, 27e. Expérience : le Feu de vie & l'air intérieur ne ſe trouvant point attaqués au coffre, il n'auroit pu eſſuyer qu'une aſſommante commotion, qui peut-être ne l'eut pas tué ; mais ſuppoſé qu'elle eut été aſſez forte, ce qu'on n'eſtime pas ; alors il eut ſeulement été étouffé, & on n'eut pas trouvé ces irruptions de l'air & de feu, avec des taches dans les differentes parties déſignées.

Ce triſte Phénomene mettra tous nos Philoſophes en garde, & mon Traité, certain dans les Expériences, leur apprendra la Cauſe Electrique, & les fera juger plus ſainement des effets.

Je ſuis Monſieur, V.

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